October 23, 1961

Aviation Week and Space Technology

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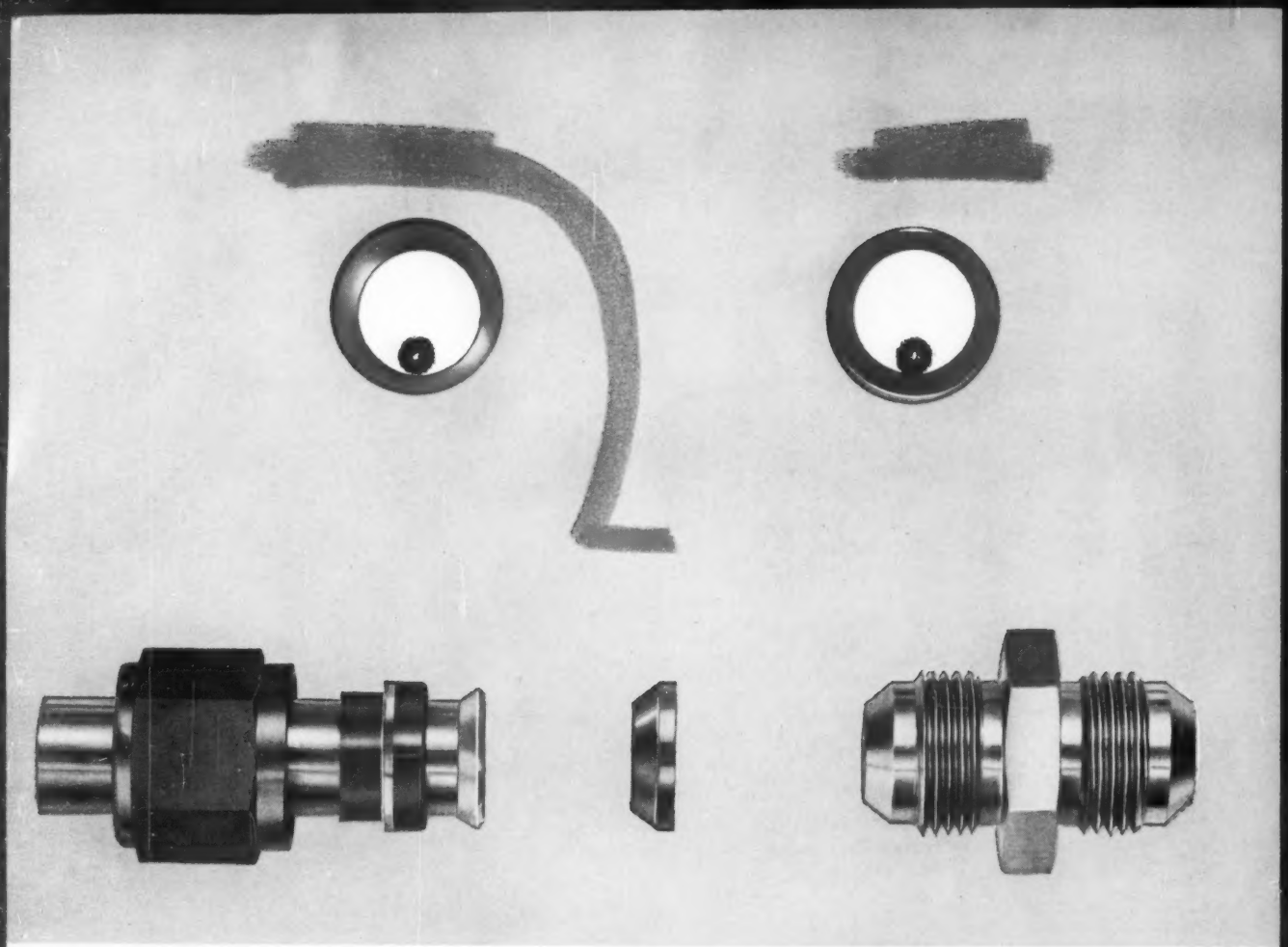
Survey Shows Urgent Avionic Research Areas

Martin Bullpup Bs On Douglas A4D

Special Report:

IATA's 17th Annual General Meeting



* Manufactured Under License From General Dynamics Corp.

Look into—CONICAL SEALS, by Voi-Shan*

The **Conical Seal** is a soft, malleable crush washer designed for the conical sealing surface of the AN type flared fittings.

Leakage problems often exist in low viscous gas systems where the conical surfaces of flared fittings and mating tubes are damaged due to manufacturing and handling procedures. The Voi-Shan **Conical Seal** flows into these imperfections and closes off the joint. Slight variations in concentricity are also corrected by the use of the **Conical Seal.**

Four equally spaced friction flats hold the seal in place until the connection is torqued-up. The seals are Lox cleaned and packaged to insure contamination-free service. The **Conical Seal** is available in copper, copper-tin plated, aluminum and nickel. These material variations allow for compatibility and galvanic action problems. The seals are available from stock in the -2 through -48 line sizes.

Voi-Shan's latest fitting design is a superior replacement for the present AND 10050 Boss design that eliminates the present use of the rubber "O" ring by incorporating the **Conical Seal** into the Boss. This is accomplished by a shorter depth due to the removal of the "O" ring, while still allowing use with the standard AN fittings. Advantages of this new design are:

1. Increase of the temperature spectrum from the −40 F to +400 F range to −420 F to +1500 F range.
2. Extended valve life: Due to greater resistance to temperatures in **Cryogenic** and **Radiation** applications.

Voi-Shan also offers the **Scott Connector System**, which is a lightweight small envelope replacement for present flared and flareless fittings.

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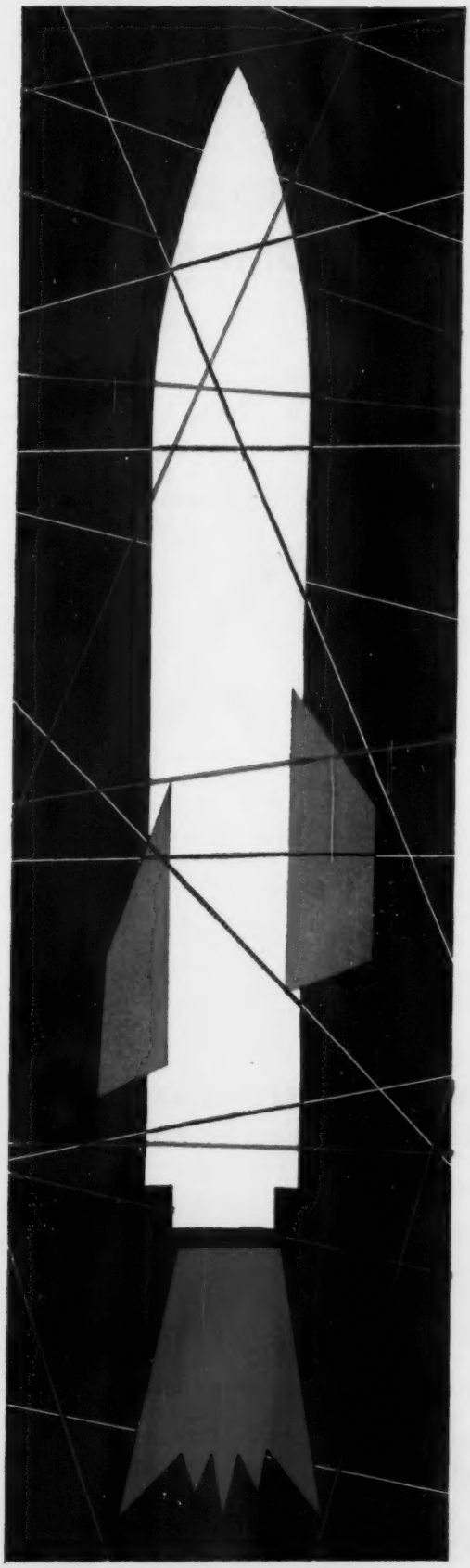

TEFLON® 100 FEP

now covered in MIL-W-16878D for military electronic hook-up wire

To electronic designers in the missile area, new opportunities are now open for improved wiring reliability. The recently issued "D" revision of Bureau of Ships' MIL-W-16878 specification for missile hook-up wire covers Du Pont TEFLON 100 FEP resin as insulation for continuous service up to 200°C.

Three constructions are included in the new spec:

Type KT—250 v. service (6-mil insulation)
Type K—600 v. service (10-mil insulation)
Type KK—1,000 v. service (15-mil insulation)

In all three types of constructions, the designer can obtain TEFLON FEP over either tin-plated or silver-plated conductors —in unlimited lengths.

In many constructions, the excellent dielectric properties of TEFLON FEP resin . . . its thermal stability . . . its low-temperature toughness . . . and its inertness to all chemicals and solvents will provide significantly increased reliability.

With this recent inclusion, FEP joins the older members of the family of TEFLON fluorocarbon resins—the TFE resins—as approved insulations meeting MIL-W-16878. Only TFE and FEP resins are permitted for thin-wall constructions under this spec.

Another military application utilizing TEFLON FEP resin is covered in MIL-C-17C—jacketing material for coaxial cable.

For more information about the properties and advantages of hook-up wire insulated with FEP resin, write to E. I. du Pont de Nemours & Co. (Inc.), Dept.AV-10,Room 2526T, Nemours Bldg., Wilmington 98, Delaware.

In Canada: Du Pont of Canada Limited, P. O. Box 660, Montreal, Quebec.

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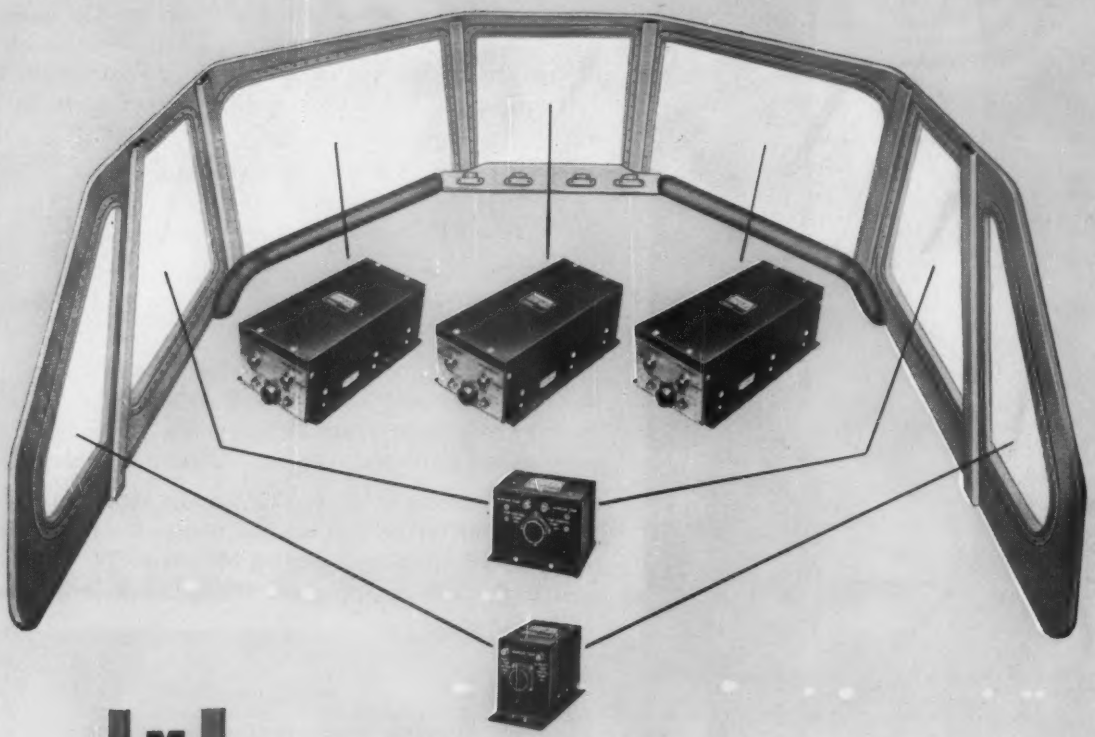

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Oct. 30-31—Aero/Space Fluid Power Conference, Pick-Fort Shelby Hotel, Detroit, Mich. Sponsor: Aero Hydraulics Division of Vickers, Inc.

Oct. 30-Nov. 1—Annual Meeting, Air Traffic Control Assn., Deauville Hotel, Miami Beach, Fla.

Oct. 30-Nov. 1—Technical Symposium on Aerothermoelasticity, Biltmore Hotel, Dayton, Ohio. Sponsor: Aeronautical Systems Division, Air Force Systems Command.

Oct. 31-Nov. 2—Fall Meeting, Radio Technical Commission for Aeronautics, Washington Hotel, Washington, D.C.

Nov. 1-3—First International Congress on Experimental Mechanics, Society for Experimental Stress Analysis, Hotel New Yorker, New York, N. Y.

Nov. 1-3—"Issues and Challenges of Air Transportation" Symposium, Hartford, Conn. Sponsor: Connecticut General Life Insurance Co.

Nov. 6-8—Special Technical Conference on Non-Linear Magnetics, IRE, Statler Hilton Hotel, Los Angeles, Calif.

Nov. 6-8—Annual Convention, American Documentation Institute, Somerset Hotel, Boston, Mass.

Nov. 6-8—Briefing Session: Military Preservation & Packaging, Ambassador Hotel, Los Angeles, Calif.

Nov. 6-9—1961 Conference and AtomFair, Atomic Industrial Forum and American Nuclear Society, Conrad Hilton Hotel, Chicago, Ill.

(Continued on page 6)

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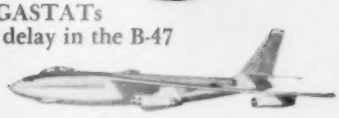

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AVIATION CALENDAR

(Continued from page 5)

Nov. 7-9—Seventh Conference, Radio Interference Reduction and Electronic Compatibility, Armour Research Foundation, Illinois Institute of Technology, Chicago.

Nov. 8-11—62nd Meeting, Acoustical Society of America, Cincinnati, Ohio.

Nov. 9-10—Fifth Annual Display, Aerospace Electrical Society of San Diego, Balboa Park, San Diego, Calif.

Nov. 9-10—11th National Conference, Aircraft and Missiles Division, American Society for Quality Control, Ambassador Hotel, Los Angeles, Calif.

Nov. 13-14—Electrically Exploded Wire Conference, Kenmore Hotel, Boston, Mass. Sponsor: Thermal Radiation Laboratory, Geophysics Research Directorate, AF Cambridge Research Laboratories.

Nov. 13-16—Conference on Magnetism and Magnetic Materials, Institute of Radio Engineers, Hotel Westward Ho, Phoenix.

Nov. 14—Symposium on Electronic Systems Reliability, Institute of Radio Engineers, Kansas City, Mo.

Nov. 14-16—Northeast Electronics Research and Engineering Meeting, Institute of Radio Engineers, Commonwealth Armory and Somerset Hotel, Boston, Mass.

Nov. 15-17—19th Annual Aerospace Electrical Society Display, Pan Pacific Auditorium, Los Angeles, Calif.

Nov. 19-22—Symposium on Biomedical Aspects of the Space Sciences, University of California at Los Angeles, Los Angeles, Calif. Sponsors: Brain Research Institute, UCLA; Air Force Office of Scientific Research.

Nov. 19-24—Medical and Biological Problems in Space Flight Conference, Nassau, Bahamas.

Nov. 27-Dec. 1—Army-Industry Aviation Logistics Symposium, Congress Hotel, St. Louis, Mo.

Nov. 28-30—38th Meeting, Aviation Distributors and Manufacturers Assn., Jung Hotel, New Orleans, La.

Nov. 30-Dec. 1—12th National Conference, Institute of Radio Engineers' Professional Group on Vehicular Communications, Radison Hotel, Minneapolis, Minn.

Dec. 4-5—Beryllium Metallurgy Conference, New York University's Washington Square Center, New York, N. Y.

Dec. 5-7—Annual Convention, National Aviation Trades Assn., Statler Hilton Hotel, Washington, D. C.

Dec. 12-14—Eastern Joint Computer Conference, Sheraton Park Hotel, Washington, D. C.

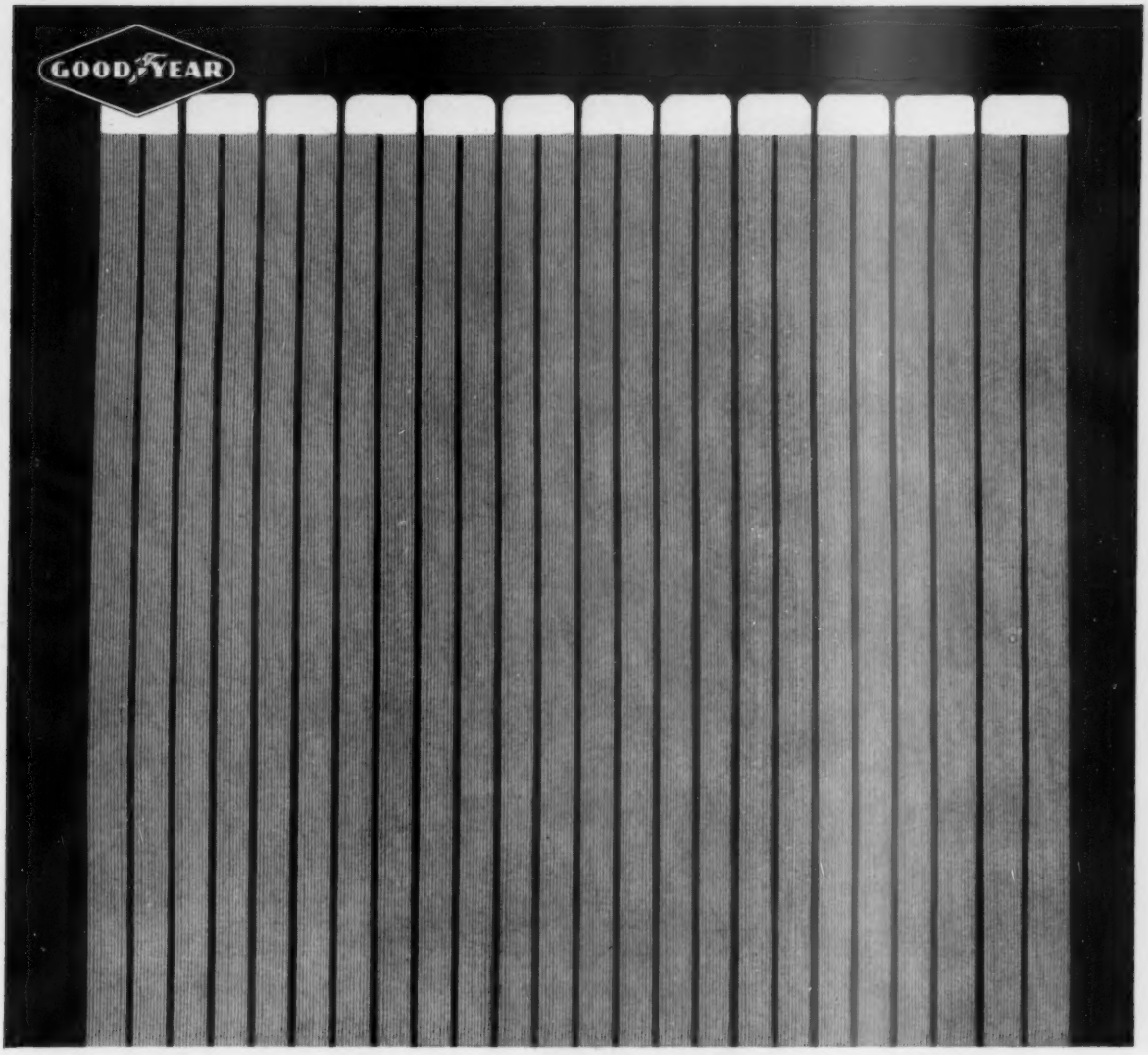
Dec. 18—25th Wright Brothers Lecture, Natural History Bldg., Smithsonian Institution, Washington, D. C.

Jan. 9-11—Eighth National Symposium on Reliability and Quality Control, Statler Hilton Hotel, Washington, D. C.

Jan. 22-24—30th Annual Meeting, Institute of the Aerospace Sciences, Hotel Astor, New York, N. Y. Honors Night Dinner, Jan. 30.

Jan. 23-26—Third Annual Solid Propellant Rocket Conference, American Rocket Society, Baylor University, Waco, Tex.

Feb. 7-9—Third Winter Convention on Military Electronics, IRE, Ambassador Hotel, Los Angeles.



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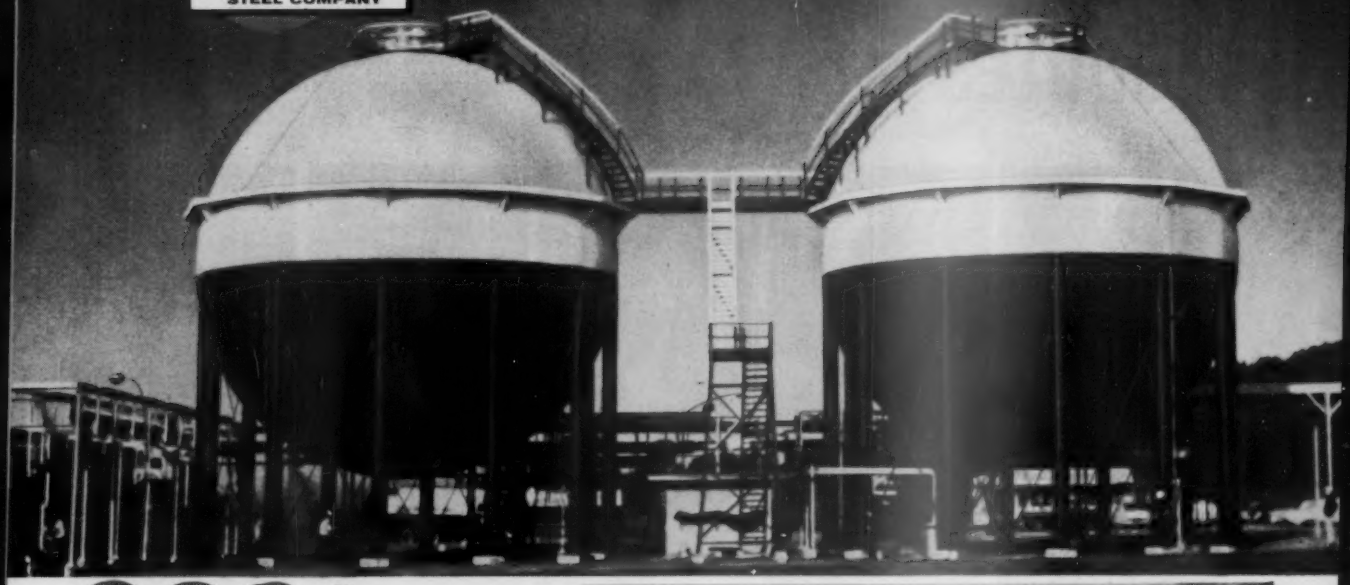

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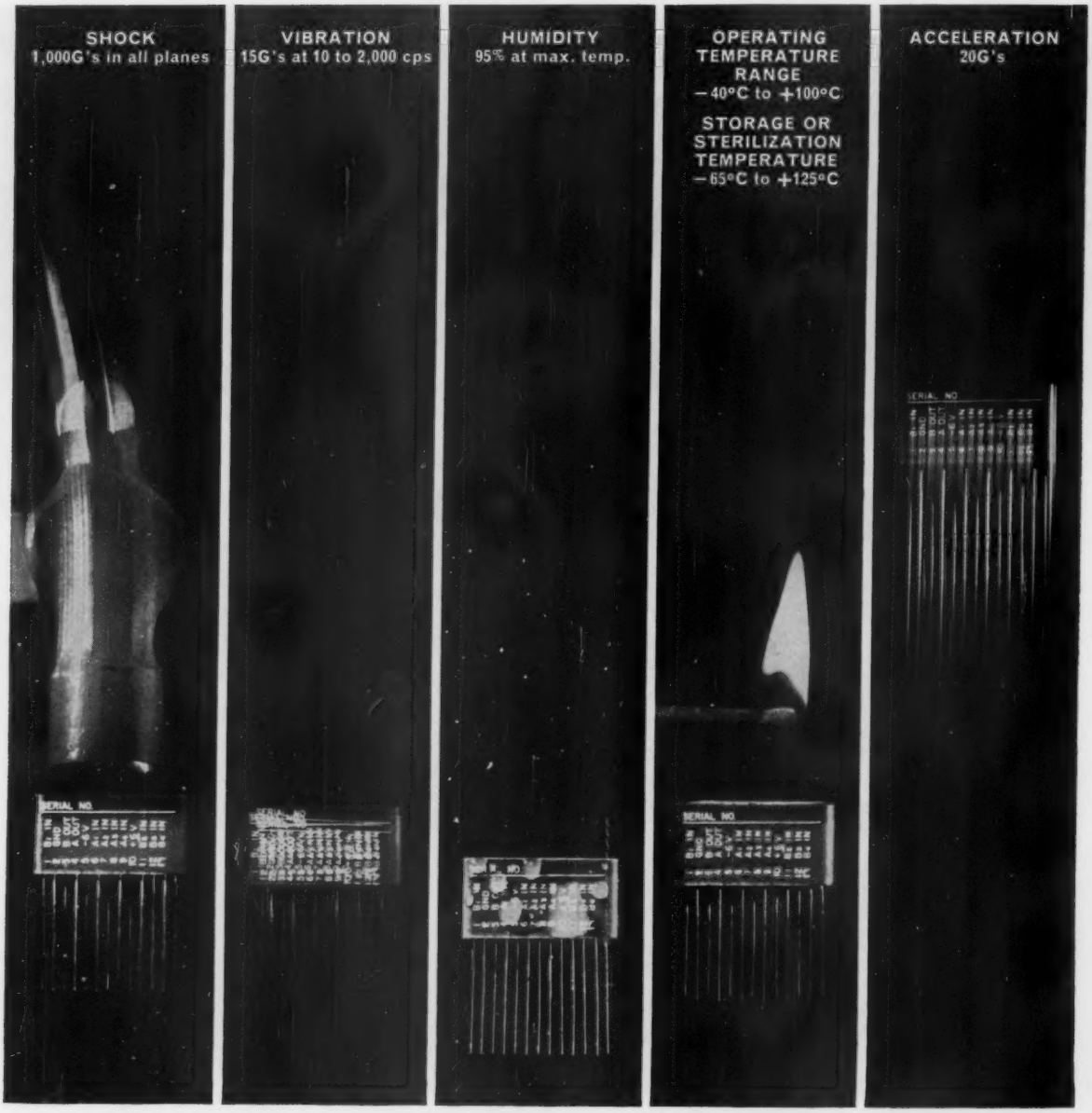

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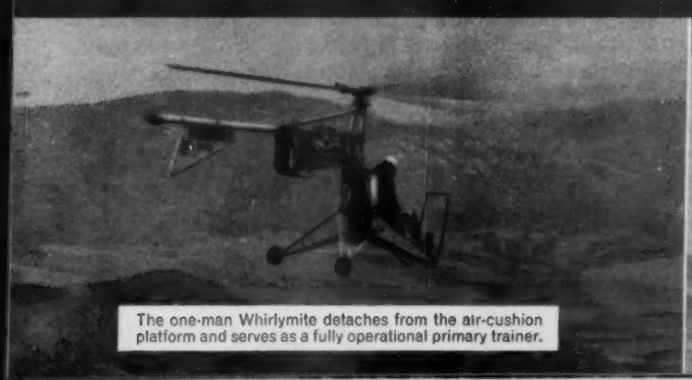
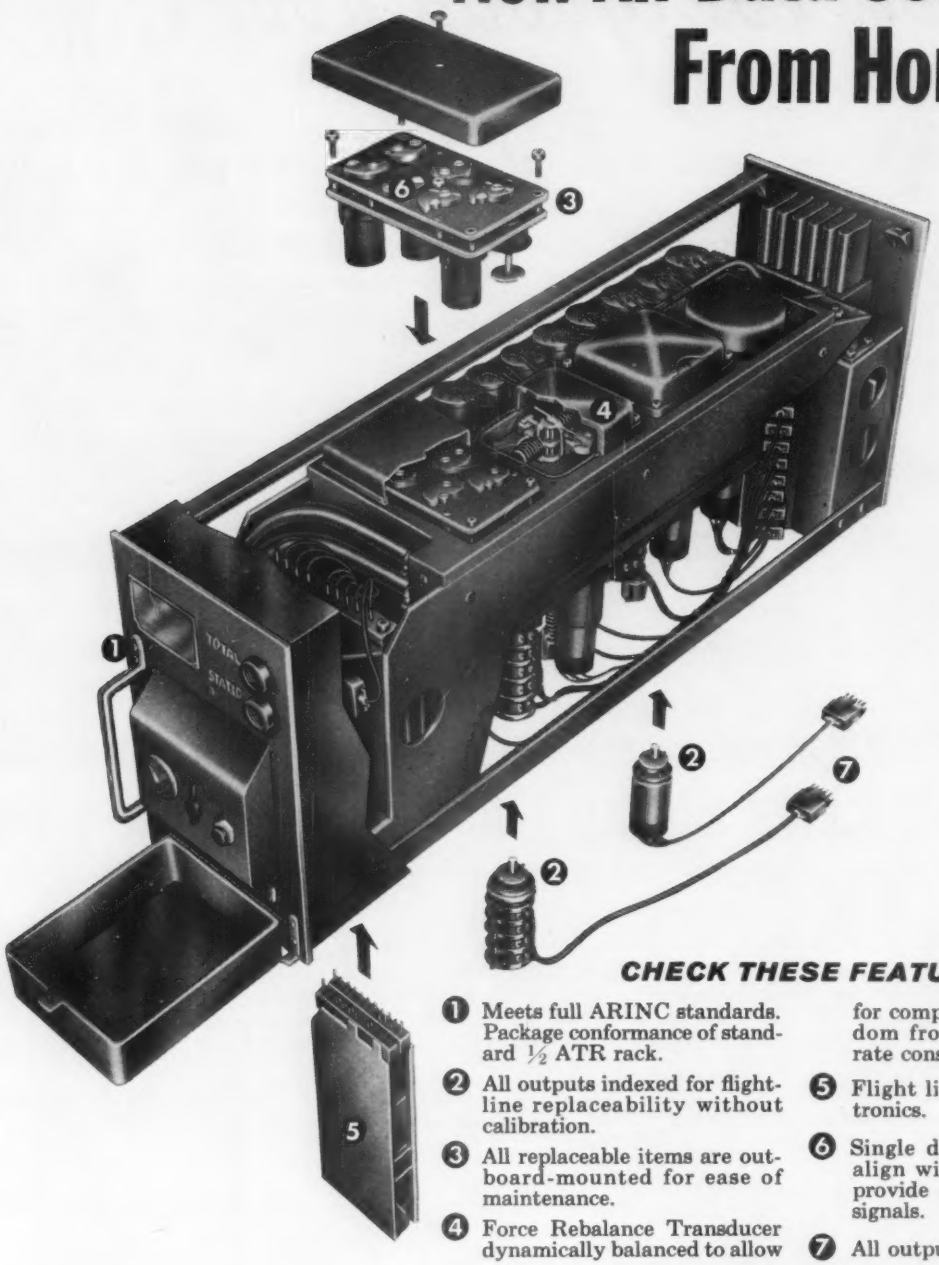


The one-man Whirlymite detaches from the air-cushion platform and serves as a fully operational primary trainer.

Del Mar's Whirlymite Self-Trainer system is presently programmed for evaluation by the U.S. Army.

New Air Data Computer From Honeywell



CHECK THESE FEATURES:

1. Meets full ARINC standards. Package conformance of standard ½ ATR rack.
2. All outputs indexed for flight-line replaceability without calibration.
3. All replaceable items are outboard-mounted for ease of maintenance.
4. Force Rebalance Transducer dynamically balanced to allow for complete installation freedom from acceleration and rate considerations.
5. Flight line replaceable electronics.
6. Single dimension tape cams align without special tools; provide extremely clear rate signals.
7. All outputs are plug in.

Honeywell's Air Data Computer system meets the wide range of needs of commercial transport aircraft. Fulfills the complete requirements set forth by the AEEC subcommittee for ARINC. By modular construction the basic system can be expanded as requirements change.

For complete information and specifications, contact your local Honeywell representative, or contact Mr. R. W. Petersen, Honeywell Aeronautical Division, Minneapolis 40, Minnesota. Telephone: Area Code 612, STerling 1-8011, Extension 5374.

Honeywell

Military Products Group

October 23, 1961

Aviation Week and Space Technology

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COVER: Navy/Martin Bullpup Bs are carried beneath a Douglas A4D Skyhawk over Edwards AFB. Now in advanced development by the Navy and Martin Co.'s Orlando, Fla., Division, the Bullpup B is a follow-on version of the Bullpup air-to-surface missile which has been operational since early 1959. Navy version pictured is designated ASM-N-7B. Air Force follow-on version is the GAM-83B. Both will have nuclear warhead capabilities and a range of about 50 mi. (AW June 12, p. 23).

PICTURE CREDITS

Cover—Douglas; 29—Ford Aeronutronic; 38, 39—National; 55—Sperry Gyroscope; 57, 61—Spacelabs, Inc.; 69, 91, 95, 96 (top)—David A. Anderton; 71—Grand Central Rocket Co.; 87 (bottom)—Goodyear; 96 (bottom)—Sperry Gyroscope; 102, 103—Beech; 107, 109, 111, 115—Cessna.

87,765 copies of this issue printed

Satellites of the U.S. Air Force MIDAS (Missile Defense Alarm System) program are designed to see a weird infrared world – a complex pattern of heat waves. As they endlessly circle the earth, they'd pay no attention to the patterns of peace: the intense heats generated by foundry, forge, and factory. But should an all-out missile attack be launched against us, MIDAS would report it instantly – *doubling* the warning time we'd get from present systems.

To tell in advance how MIDAS will work when actually on orbit, Lockheed put its infrared components aboard the Agena satellites originally used in the Air Force's trail-blazing Discoverer program. This happy hybridization is contributing significantly to the MIDAS development program – at a minimum cost in days and dollars.

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EDITORIAL

Economic Effects of Space Flight

Don G. Mitchell, vice chairman of the board of General Telephone & Electronics Corp., reviewed the economic effects that the space program will have on industry during a panel discussion on the global effects of space flight at the recent American Rocket Society Space Flight Report to the Nation. Because of the direct interest of aerospace firms in the trends that he forecasts, AVIATION WEEK *is publishing excerpts from his talk.*

I would like to concentrate my attention on the tremendous contributions which space science and technology will make to the entire spectrum of research and engineering in the future.

I am speaking of a kind of chain reaction. Our scientific knowledge and our skills in applying that knowledge are directed toward meeting the challenge in outer space. As a result, new fundamental knowledge is unearthed and further advances are made in engineering, which in turn is fed back into many fields of endeavor. This phenomenon has occurred before.

However, space science and technology will surely transcend all of the other examples because it is not an industry in itself but reaches across all industries, directly and indirectly. As rocket engines of greater and greater thrust are developed, the state of the art in chemistry and metallurgy is steadily advanced. By the same token, the development of new types of rocket fuels will feed back new information and new techniques to the entire chemical industry. We will see such specific benefits as relatively simple and highly efficient powerplants for aircraft and automobiles, and entirely new concepts in power generating equipment.

The entire field of instrumentation in its broadest sense will benefit greatly from the new electronic, hydraulic, and mechanical systems and devices used in the launching and guidance of space vehicles. Electronics particularly has made many contributions to space flight, but it will also be one of the prime beneficiaries.

Great advances have been made in electronic guidance and control equipment because of the requirements of space flight—and these developments will be translated into improvements in commercial aircraft control, guidance and navigational systems, data processing, and the many related areas of electronics. . . .

A fascinating new field of research has evolved out of the studies being made on the effects of space flight upon the human being. Aside from the obvious physiological requirements of sustaining life by providing air, food and water under the highly abnormal environment of space flight, there is the added factor of the psychology of space flight—the reactions of the human being as he orbits the earth at tremendous speed, and the resultant demands upon his mental processes.

As the perplexing problems of re-entry of space vehicles into the earth's atmosphere are solved, entirely new concepts of metallurgy will emerge—especially new combinations and forms of metals capable of withstanding enormous heat and pressures—and these developments will find their way into many other industrial applications.

We will develop new understanding of radiation, not only in terms of protecting ourselves from it, but far more important, harnessing this phenomenon to work for us.

Great advances have been made in understanding the weather, and whereas attempts so far to exercise weather control through cloud modification have not proved successful on a large scale . . . the sum total of our knowledge is growing steadily. . . .

The potentials are especially strong in space communications—the use of satellites in outer space to form the nucleus of a vast new world-wide communications system. Its possibilities are limited only by the imagination. . . .

However, no matter what field we are talking about, the many direct and indirect benefits to be derived from this nation's space projects are no more than potentials. The big challenge to the individual companies in American industry is to assure that they are sufficiently advanced in research and development to recognize an opportunity when they see it.

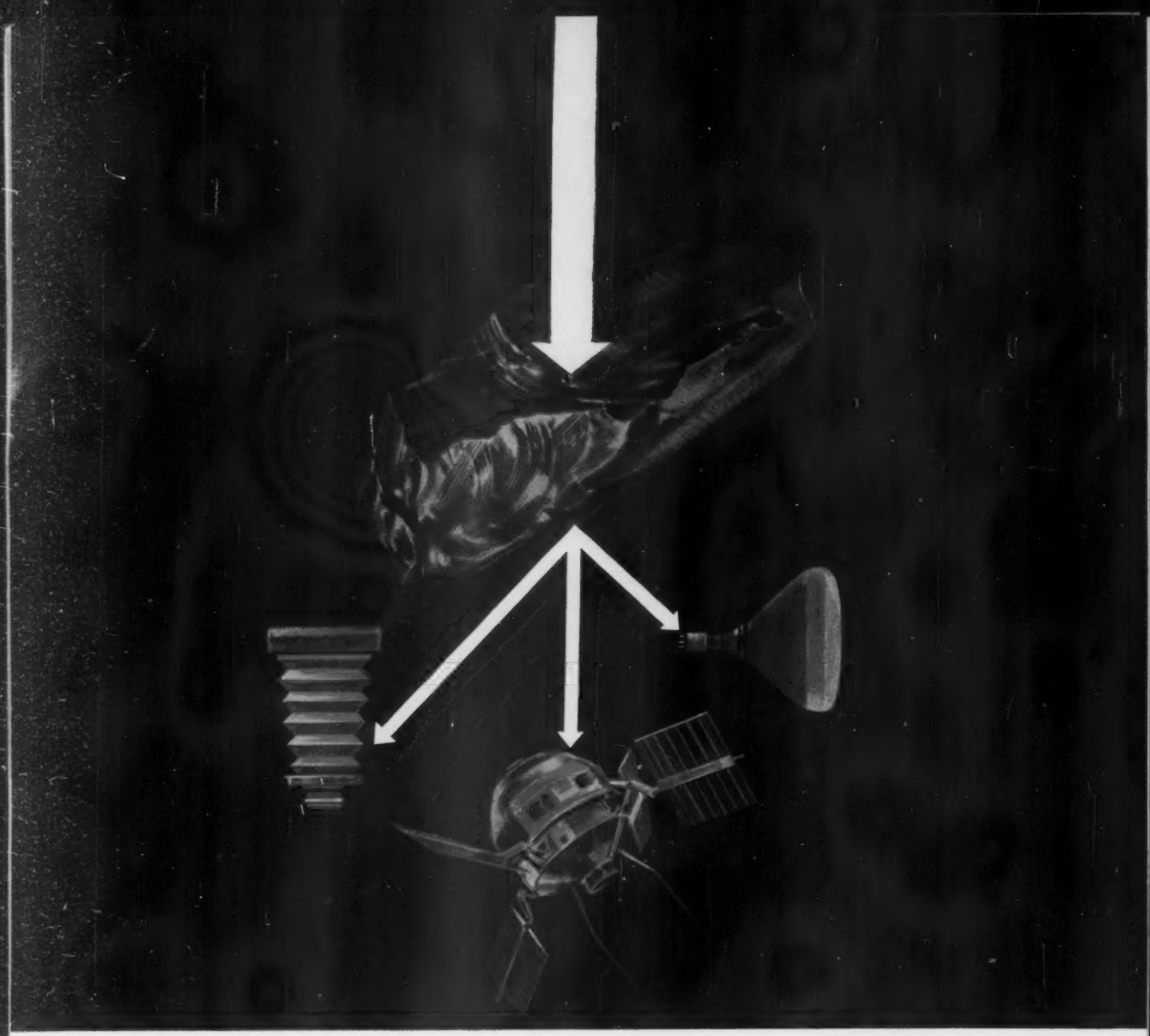
The total expenditures by industry on research and development this year will exceed $10 billion. That total is more than triple the amount spent ten years ago. And yet we have barely scratched the surface in unearthing new information and developing new products and services. Industry's research and development expenditures must be more than doubled over the next seven or eight years, to a total of at least $20 billion annually. The handwriting is on the wall, and that handwriting is: Today's research is the key to tomorrow. And I am not talking about token or minimal research so that you can say you are doing research. I am talking about strong, productive research—that will assure your company a role in the future, in space technology or any other technology.

Just as the future will bring a host of changes in the laboratory and the manufacturing plant, it will bring changes in just about every aspect of industrial operations. The big question is management's ability to sense that changes are occurring, and then to do something about them. This is not easy in these days of complex current problems. How can management pay sufficient attention to the future when coping with the present is difficult enough as it is? Management has no alternative; as space technology unfolds—and it is unfolding at a rate that is practically exponential—management will have to do a far more complete and more interpretive job of long-range planning. That is the only way that we will be able to give the vital sense of direction and purpose to our space efforts, by appraising the opportunities ahead of us, and developing courses of action to take full advantage of them. To put it another way, it means setting new goals and greater goals, and going about setting a sound course to reach them.

Meeting this need will be a difficult task because of the increasingly complex nature of industry. A few years ago, companies tended to fall into rather clearly defined categories. . . . But the picture has changed. Today we have the great corporate pluralists, and they are getting more "plural" all the time. This has stemmed, of course, from the greatly increased emphasis on research and development which has provided tremendous incentive to diversification, and yet far greater diversification and increasingly technical products will confront all of us in the years ahead.

Industry had some fairly predictable targets back in 1957 when the first Sputnik was fired. But this is no longer true. With the advent of the space age, we have moved into an entirely new operating environment, which is requiring us to superimpose an entirely new set of situations upon our familiar operations. You can get some idea of the scope of this activity when you bear in mind that more than 5,500 industrial organizations, private laboratories, and universities are participating in various aspects of the space program—ranging all the way from highly advanced research to the production of hardware.

In the years ahead, this activity will broaden tremendously, and all of us in industry will need to be the astronaut's industrial counterpart, looking at the future with imagination, tenacity of purpose, and ingenuity. Otherwise, we will never get off the launching pad.



FAIRCHILD BASIC RESEARCH LABORATORY ADDS A NEW DIMENSION TO PHOTOGRAPHIC CHEMISTRY

New insight regarding the interaction of light with solid state photosensitive surfaces is now being gained at Fairchild's Basic Research Laboratory. Defense Products Division scientists are also discovering new facts about the role of free radicals and molecular complexes in the photographic development process. Such knowledge can produce photographic materials of unprecedented speed and resolution which are capable of virtually instantaneous processing. Another result can be very thin solar cells of wide area and sensitive to radiation from the ultraviolet to the infrared which can be of great value in space exploration. Vastly improved developers can also be foreseen in new data concerning photographic chemistry. This basic and applied research and development is contributing advanced products and techniques for military and industrial application, assuring Fairchild's continued leadership in the photographic field. The Basic Research Laboratory and its achievements are available for your programs. For a brochure and further information, write the Director of Marketing, Defense Products Division.

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Engineers and scientists are invited to discuss new opportunities presented by continuing growth of the Defense Products Division.

WHO'S WHERE

In the Front Office

H. A. Shepard, vice president and general manager, Thompson Ramo Wooldridge, Inc., Los Angeles, Calif.

Paul Mazer, president, Avions Max Holste, Reims, France.

Dr. John Anthony Hrones, a director, CompuDyne Corp., Hatboro, Pa. Dr. Hrones is vice president for academic affairs of Case Institute of Technology.

Charles A. Ulsh, vice president-manufacturing, Canadair, Ltd., Montreal, Canada, and **Donald A. Dixon,** director-aircraft manufacturing.

Houston D. Silliman, a vice president, American Airlines, Inc. Mr. Silliman continues as American's Chicago manager.

Dr. Charles H. Stockman, vice president and general manager, Goodrich High-Voltage Astronautics, Inc., Burlington, Mass.

Philip B. Taylor, former assistant secretary of the Air Force for materiel, elected a director of The Marquardt Corp., Van Nuys, Calif.

George W. Heath, president, United Aircraft Supply Corp., Chicago, Ill., succeeding **Ralph Odegard,** retired.

I. W. Thompson, president of the newly formed Thompson Industries Division of Space Equipment Corp., Torrance, Calif. He continues as a corporate vice president and director of Space Equipment.

Dr. G. J. Harbold, bio-project acoustics director, Life Science Department, Pacific Missile Range, Point Mugu, Calif.

Honors and Elections

Jerome F. Lederer, director of the Flight Safety Foundation and the Cornell University Guggenheim Aviation Safety Center, will receive the 1961 Daniel Guggenheim Medal next month. American Society of Mechanical Engineers, Society of Automotive Engineers and Institute of the Aerospace Sciences, sponsors of the medal, will honor Lederer for "lifelong dedication to the cause of flight safety and his constant and untiring efforts to reduce the hazards of aviation."

W. Z. Stepniewski, assistant director-engineering for research for Vertol Division of The Boeing Co., has been awarded the Enoch Thulin Medal by the Swedish Aeronautics Society for his contributions to the advancement of aeronautics.

Changes

Dr. Wilbur A. Hane, chief scientist, Boeing Aero-Space Division, Seattle, Wash. **E. N. Sidor** succeeds Dr. Hane as chief of physics technology.

Nicholas M. Stefano, project design engineer-Minuteman ICBM weapon system, Mechanics Division, Space Technology Laboratories, Inc., Los Angeles, Calif.

Louis J. Daukas, divisional counsel-contracts, Connecticut operations of Pratt & Whitney Aircraft Division of United Aircraft Corp., East Hartford, Conn., succeeding **Edwin L. Davis,** now executive assistant to the general manager of Pratt & Whitney's Florida Research and Development Center, West Palm Beach, Fla.

INDUSTRY OBSERVER

► Most frequently mentioned size for an Apollo follow-on spacecraft is a seven-man version. Proposals range up to a 15-man version. The three-man Apollo could be expanded to carry five if the vehicle's service module were equipped with sufficient life support equipment. Follow-on that is finally selected will be determined largely by availability of boosters.

► **Proposals for a design study of a radiation weapon or "death ray" using high energy light beams of optical masers have been requested from industry by USAF's Rome Air Development Center. Proposals are due early next month.**

► Russian design team headed by Oleg K. Antonov is working on a variety of new STOL aircraft types, including one with several jet engines. Radio-controlled models of the craft were demonstrated to Soviet reporters recently at Antonov's Kiev plant.

► **Frequency in the K_a band, at roughly 13.5 gigacycles, probably will be selected as the optimum operating frequency for the Dyna-Soar boost glider's communications system. Chief advantage of a system using this band is its ability to transmit through the ionized sheath that surrounds vehicles re-entering the earth's atmosphere and prevents use of many microwave frequencies (AW Aug. 28, p. 23).**

► Naval Research Laboratory hopes to launch a Lofti II satellite, similar to the first, into a highly inclined orbit within the next few months to continue experiments in very low frequency propagation. Results of the first experiment were limited by failure of the second stage of the Transit vehicle to separate from the Transit and Lofti satellites, which prevented Lofti's dipole antenna from extending.

► **Four Loran-C navigation networks, which can be used by Polaris submarines for precise determination of position, recently have been installed in the Mediterranean and Norwegian seas and the north and central Pacific Oceans. The Sperry-developed system enables submarines to establish launch sites whose positions are known to within several hundred feet, to which they can proceed by inertial navigation after hostilities begin.**

► Avco's Lycoming Division has begun testing a reduction gearbox developed at its own expense that would convert its turboshaft T55 engine to a turboprop powerplant which ultimately would produce about 2,900 eshp. Lycoming has indicated it would like to flight test the new gearbox on a de Havilland Caribou but Army—which is Lycoming's prime military customer—has not yet offered financial support.

► **Among the possible boosters being studied by Martin Co. is a two-stage vehicle for direct ascent to the moon, with the booster using 24 Rocketdyne J-2 liquid hydrogen engines. Booster would be about 40 ft. in diameter and 150 ft. tall. Martin has investigated availability of propulsion wind tunnel time for test firing a scale model.**

► Investigations by USAF's Aeronautical Systems Division, aimed at overcoming compressor blade stall in turbine engines operating at extreme altitudes, have shown that automatic feedback of air from the high pressure section to the engine inlet area will permit flight at much higher altitudes.

► **Recent failure of the first attempt to launch a Minuteman from a silo (AW Sept. 18, p. 63) has been attributed to a spurious second stage ignition signal generated by the guidance and control system when a soldered connection broke loose.**

► First General Electric Bios probe is scheduled to be launched by an Argo D-8 from the Pacific Missile Range Nov. 15 to coincide with meteor showers expected then.

SILICOLOGY *Studies in Silicones*

HOW THESE TIME-TESTED MATERIALS CAN WORK FOR YOU

Silicone Rubber Takes to the Air ...And a Customer Tells Us Why

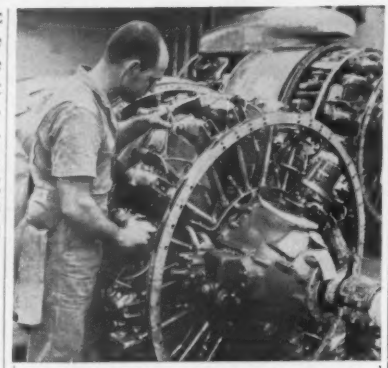
A recent letter from a UNION CARBIDE Silicone Rubber customer is one of those that makes us like to read our mail. We quote parts of it below in the hope that it will serve as a "refresher" on the properties that have made silicone rubber virtually indispensable in modern aircraft.

The letter is from the Engineering Laboratories of the Electric Autolite Company, Wire and Cable Division, Port Huron, Mich., which states:

RESISTS OZONE, CORONA, COLD, AND MOISTURE

"Silicone rubber, because of its excellent heat resistance and dielectric strength, has been specified as insulation on aircraft lead wire for a number of years. More recently, these same properties have promoted its use on ignition cables for automobiles, aircraft, and military vehicles. Spark plug boots, attached to the cables, are also molded of silicone rubber because of the continuous high temperatures to which they are subjected.

"In addition to dielectric and heat-resisting properties, there are other advantages in the use of silicone extruded insulation. It is readily compounded for extrusion, extrudes smoothly, and strips easily from the conductor; the finished wire has excellent shelf life as well as good service life, it can be used at high altitude, remains flexible at low temperatures, and resists ozone, corona, and moisture."



SILICONE rubber-insulated wire and cable, capable of withstanding continuous high temperatures, is used in powerful aircraft engines.

MORE RELIABLE FOR CARS, TOO

The letter gives a forward-looking hint to Detroit as it goes on to state: "Newer automobile engine designs, for greater efficiency by operation at higher temperatures, should further increase the requirements for this more reliable ignition cable.

"UNION CARBIDE Silicone Rubbers are among those used for The Electric Autolite Company's insulated wires and cables, and their KW-1330 silicone rubber base has been approved for use on ignition cables."

Bendix Corporation, Scintilla Division, is one of Autolite's customers. Bendix in turn supplied the silicone-insulated spark plug leads for engines that power such giants of the skies as the Lockheed Super Constellation-type radar airplanes, designated by the United States Navy as WV-2. Able to range far out to sea and carry out special early warning missions, this long-distance plane carries America's most powerful search radar to high altitudes to avoid normal limitations from radar's inability to bend over the horizon.

WHERE CAN SILICONES BENEFIT YOU?

You'll also find silicone-insulated ignition cables boosting the reliability of military vehicles, tanks, and trucks. And if you're a track fan, they're virtually a "must" to stock car racers.

Aircraft technology and development are changing more rapidly than ever before. Perhaps you are overlooking a good bet—some place in the design of your products where a UNION CARBIDE Silicone Rubber can serve you, improving quality at a surprisingly low cost. Send the coupon for further information.

U. S. NAVY'S WV-2 far-flying sentinel, which can stay airborne for extended periods of time, carries America's most powerful search radar as part of the nation's defense against sneak attacks.

UNION CARBIDE

SILICONES

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Washington Roundup

Civil-Military Space

National Security Council had an impromptu discussion of the civil-military division of space projects on Oct. 13 as the result of newspaper reports of Gen. Bernard A. Schriever's remarks on the subject at the American Rocket Society Space Flight Report to the Nation. The security council, which leaves such matters to the National Aeronautics and Space Council, came to no conclusions and took no action.

Vice President Lyndon Johnson, who heads the Space Council, is fully aware of the dissent within the services over the division of space missions but is impressed with National Aeronautics and Space Administration, because the civilian agency speaks with one voice through Administrator James E. Webb. He has indicated he would like to see Defense Department do the same.

Development of Air Force's long-sought medium-range ballistic missile (MRBM) to cover tactical ranges over 100 mi. has been ordered by Defense Department. Army's Pershing missile is limited to 100 mi. by Defense order. In reviewing Army's tactical missiles, Defense has begun taking action to eliminate the overlap in ranges. First victim in the Fiscal 1963 budget will be the 10,000 lb., 85-mi. range Sergeant, which has not yet become operational.

Solid Booster Gloom

Proponents of large solid-propellant boosters are anxiously—and somewhat gloomily—awaiting the report, due within 10 days, of the Large Launch Vehicles Group of the joint NASA-Defense Lunar Study Project. NASA has never conceded that a solid Nova vehicle should be developed parallel with a liquid-fueled Nova for direct ascent to the moon, and some observers feel the vehicles group leans rather heavily toward liquids. **The picture is complicated by Air Force's preference for solids with a maximum diameter of 120 in. NASA prefers 240-in. diameters, may compromise at 160 in.** If a solid Nova is developed it may be done slowly and as a backup only. One bright hope for solid proponents is that the group may recommend rendezvous rather than direct ascent for the lunar flight. Then NASA probably would concentrate on use of the Saturn and might not build a liquid Nova immediately. In that case, a solid Nova project is almost certain. Air Force would like to try to build a 20-million lb. thrust solid booster under a two-year crash program to strengthen its own role in space.

Russia's monthly Soviet air force bulletin will be reorganized next January and issued under a new title: "Aviation and Cosmonautics."

Concern Over Midas

Defense Department is concerned over slippage in the Midas early warning satellite program and apparently has even considered shifting management of it from Lockheed to the Aerospace Corp. Some parts of the program are 10 months behind schedule. At least one mission—use of a Midas to scatter tiny metal dipoles that will form a radio-reflecting belt under Project West Ford—has been delayed for political and technical reconsideration of the feasibility of such a belt.

Several aerospace firms in the Boston area are mapping a new strategy in their attempts to have Congress change space patent law **(see p. 30)**. Patent lawyers who have appeared at earlier hearings feel they got chilly receptions, apparently because lawmakers see them as having vested interests in a new law. So the Boston firms will send company presidents instead. As a part of the same campaign, the Government Activities Committee of the Boston Patent Law Assn., representing some 15 firms, has drafted a study designed to show that federal legislation is steadily eroding industry's patent rights.

Transportation Report

Commerce Secretary Luther Hodges' report to President Kennedy on a national transportation policy, which he hopes to deliver by Nov. 1, will recommend specific legislation and executive action to strengthen transportation and will not be just another research study, Hodges has indicated. The secretary also has warned that the report will recommend actions that will cause unhappiness in some segments of the transport industry.

John Rubel, assistant secretary of defense for research and development, was scheduled to visit European countries this week for further discussions on exchanges of research and development knowledge and projects with the U.S. He also will inspect some facilities of the National Security Agency, which now reports to him.

USSR said Lt. Col. Mikhail Romanovich Voronov, who allegedly downed the U-2 reconnaissance aircraft with one "super-precise" rocket shot, was unanimously elected as delegate to last week's 22nd Communist Party Congress by his soldiers, to whom he is teaching "the art of sharp shooting." Voronov's feat "became known the world over," Russia said. "Some sincerely admired it, others raged with fury, but no one remained indifferent."

—Washington Staff

Centaur Payloads Cut by Reorientation

Project has grown into key learning tool at cost of time, money; first launch is expected in January.

By Evert Clark

Washington—Centaur hydrogen-fueled space vehicle now is approximately one year behind its original schedule and the payload capability of early vehicles will be about one-half of what was desired. But Centaur development has been turned from a feasibility project into a basic learning tool for the whole technology of liquid hydrogen rocket engines, and the vehicle is expected to become a workhorse for lunar and planetary exploration.

First test flight now is scheduled formally for late December, but it is not expected to be made until January. The Centaur stage, which is boosted by the Convair Atlas, will be shipped to Cape Canaveral, Fla., soon.

Test flights, supplemented by what may be the most extensive ground testing program ever undertaken on a rocket engine, will last an estimated two years and will involve at least 10 launches of heavily instrumented vehicles before the twin-engine Centaur is considered a useful vehicle. Payloads will be carried on these flights, but emphasis will be on vehicle development.

The ignition problems that plagued the engine last winter apparently have been overcome, and several hundred firings, using four or five engines over the past few months have convinced National Aeronautics and Space Administration that the engine now is usable.

Engine Delivery Awaited

Delivery of engines now is the pacing item in the program because production could not be ordered until development problems were ironed out, according to Milton W. Rosen, deputy director of NASA's office of launch vehicle programs. Because of the development delays and the growth of the ground test program beyond what was planned originally, NASA could use one dozen engines right now if it had them, Rosen said.

Pratt & Whitney Division of United Aircraft Corp., developer of the LR-115 Centaur engine, will begin producing engines next year at its main plant in East Hartford, Conn. It also will continue to build them at its Florida Research and Development Center until it catches up with demand (AW Oct. 2, p. 26).

Although it was expected that the East Hartford plant might eventually take over production from the Florida center if the program advanced satisfactorily, Rosen said he regards the decision to build engines at East Hartford as the addition of a second production source.

It is easier to establish a high-volume production line there, and "we are anxious for the quality control for which Pratt & Whitney is justly famous, and this is generally found at East Hartford," Rosen said.

The severe reduction in payload capability of the early vehicles—approximately 50%—results from the great amount of instrumentation they will have to carry. This is due primarily to the newness of hydrogen rocket technology and a basic change in approach introduced by NASA's Marshall Space Flight Center when it took over Centaur development in July of last year.

Centaur was initiated in 1958 as the first hydrogen rocket engine project by Defense Department's Advanced Research Projects Agency, on the basis of work that Pratt & Whitney had been doing for the Air Force. Design of basic systems was frozen three years ago, and the original mission was to place a military communications satellite in a synchronous, 24-hr. equatorial orbit, and within plus or minus 15 deg. of the desired longitude.

Complicated Maneuver

USAF Lt. Col. John D. Seaberg, who is assigned to the Centaur management group at Marshall, described Centaur at the recent American Rocket Society Space Flight Report to the Nation as "a vehicle whose shape is dictated by its propellants and whose working parts are determined by its mission. These two in combination did not originally make a happy pair; they stretched the state of the art to its limits." He described the 24-hr. orbit mission as "one of the most complicated maneuvers known."

Rosen said at the same meeting that Centaur was "one of the most difficult vehicle projects ever undertaken by the U.S.—in some respects even more so than Saturn."

Air Force managed the project for ARPA until 1959 when Centaur was transferred to NASA. But the real change in orientation did not take full effect until the von Braun group at Marshall joined NASA in 1960 and took charge of Centaur, Rosen said.

By this time NASA had made a very heavy commitment to liquid hydrogen as a space fuel. All upper stages for the Saturn vehicle were to use it, hydrogen upper stages already were being contemplated for the larger Nova vehicle, and the Rover nuclear rocket project was to use liquid hydrogen as the working fluid.

NASA retained the "small, very good" Air Force management team and was glad to get it, Rosen said. But NASA felt that neither Air Force nor the contractors involved had provided "the powerful, basic development backup" that was needed both to make Centaur work and to prepare for future work with hydrogen engines.

"Since NASA took over, we have hit the area of learning about the basic problems harder and have amplified the amount of backup development work by at least a factor of 10," Rosen said. "We did it because if we didn't, we knew we were bound to fail."

This expansion of backup development work—at Pratt & Whitney, at Convair, the stage builder; and at NASA's Lewis Research Center, which had done much of the basic investigation of hydrogen that led to the Centaur engine contract—was under way before ignition problems caused three explosions of Centaur engines last winter.

Budget Breakdown

Ground testing of the engine was budgeted for $1.2 million in a Fiscal 1961 supplemental request and $13.24 million in the current fiscal year. Ground testing of the vehicle was budgeted for $2.2 million in Fiscal 1960, $10.35 million plus a $1.8 million supplemental in Fiscal 1961, and $5.64 million in the current fiscal year.

Total cost of the project from the time NASA took over through Fiscal 1962 is $155.6 million—approximately $94 million for the vehicle, $52 million for the engine and $15 million for system support. NASA Deputy Administrator Hugh Dryden testified last spring that the development cost was expected to be about $30 million for Fiscal 1963, compared with $56.4 million for the current fiscal year, bringing the total cost of developing the vehicle to "something a little under $200 million."

Although NASA was expanding the ground testing program before the ignition problems occurred, the trouble increased the ground test requirements—and therefore the funds needed—even more. Increasing the power of the elec-

tric ignition spark and a better control of the hydrogen-liquid oxygen mixture as it reaches the ignition area appear to have solved these problems.

Ground test program now includes:

- **Two-engine** test facility at P&W's Florida facility.
- **Test stand** for the entire stage at Convair's Sycamore Canyon, Calif., site, where acceptance tests are performed.
- **Two-engine** test facility at Edwards AFB, Calif. This uses a heavy-gage steel stage, but is chiefly for testing of the propulsion package. Tests there will last for about a year.
- **Engine tests** in an altitude tunnel at the Lewis center.
- **Plans for tests** of the complete full stage in an altitude propulsion tunnel now under construction at USAF's Arnold Engineering Development Center in Tullahoma, Tenn. This will be the first tunnel in which the whole stage can be tested in a near-vacuum, and Centaur may be the first vehicle to use it when it is completed next year.
- **Air Force Missile Test Center.** One Centaur stage has been at Cape Canaveral for several months for mating tests with the Atlas booster and with ground equipment at Pad 36-A. Army Corps of Engineers last week advertised for bids for construction of another launch site, Pad 36-B.

Flight Tests

The same thorough approach that is being applied to ground testing will be used in flight tests. For example, the first three vehicles will carry television cameras inside their hydrogen tanks to observe the behavior of liquid hydrogen in zero-gravity conditions.

Almost 800 measurements will be made on early flights—377 on the Centaur stage by telemetry and 98 by landline; and 132 on the Atlas by telemetry and 181 by landline. Atlas, which normally carries one telemetry package, will carry two to provide detailed information on structural interaction of the two stages during the maximum dynamic pressure conditions. Centaur will carry three telemetry systems, a C-band beacon for tracking by FPS-16 radar, and an Azusa beacon, which later will be moved to Atlas.

For the 24-hr. synchronous orbit mission, the Centaur stage must fire once in space to put itself and the payload into a parking orbit; coast there for 1.5 to 11 hr.; restart to put itself into an ellipse transfer lasting 5.5 hr.; and burn a third time to establish final orbit.

About two-thirds of the propellants will be used in the first burning, 24% in the second and 10% in the third. Two years of testing of hydrogen's behavior in the weightless state, using rockets, aircraft, drop tests, etc., indicate that some of the hydrogen becomes gaseous and forms an emulsion with the liquid hydrogen. This emulsion seeks the walls of the tanks, wetting and clinging to them and leaving a gas pocket in the middle.

Because solar and earth heat will cause expansion of the fuel, the tank must be vented. If the test work is borne out, this can be done relatively easily by putting the vent pipe in the center of the tank, where the gas pocket will form. But this is the kind of question which only heavily instrumented test flights can answer.

During coasting periods, the Centaur will be oriented with its hydrogen tank pointing away from the sun to minimize heating, but it still will carry several hundred pounds of insulation, including about 400 lb. of glass fiber panels some quarter of an inch thick that will cover the sides of the hydrogen tank and be jettisoned after launch. The necessity to orient the vehicle during both coasting periods also increases weight.

Another weight increase on early flights will result from use of a dual pressurization system so the technique can be evaluated safely. At ignition, stage will weigh 32,000 lb. plus the jettisonable nose fairing and tank insulation.

A great deal of the weight taken up by backup equipment and instrumentation can be eliminated later. Whether the entire 50% in payload capability lost so far can be regained is doubtful.

Rosen said NASA would not choose the bootstrap pumping cycle of the Centaur engine if it had the choice to make now, but would prefer a gas generator pumping system. At least 17 major propellant feed and pressurization schemes were investigated before the engine design was frozen, according to Col. Seaberg.

Rosen also said it would have helped if Pratt & Whitney had had previous rocket engine experience before undertaking Centaur, but pointed out that P&W had more experience with liquid hydrogen than any other firm at the time the project began.

Kennedy Leads Worldwide Protest On Soviet Plan to Test Huge Bomb

Washington—Premier Nikita Khrushchev's announcement that Russia would explode a 50-megaton nuclear bomb above the earth Oct. 30 or 31 has dismayed Western leaders and brought new pleas for disarmament.

Khrushchev at the 22nd Communist Party Congress, Oct. 17 said the blast would conclude the latest series of nuclear tests. He said, in a departure from his text, "we have a 100-megaton bomb, but we do not intend to explode it. If we happen to explode it in the wrong place, we might break our own windows. May God grant that we never have to explode such a bomb."

President Kennedy, shortly after the Khrushchev announcement, asked Russia to call off the test. Secretary of State Dean Rusk Oct. 18 said the very presence of such a bomb dictates that a disarmament agreement be reached.

The White House statement said: "We call upon the Soviet Union to reconsider this decision, if in fact it has been made. We know about high-yield weapons. Since 1957 the United States has had the technical know-how and materials to produce bombs in the 50-100 megaton range and higher. But we also know that such weapons are not essential to our military needs. Furthermore, full-scale tests are not necessary to develop 50 megaton bombs. Such an explosion could only serve some unconfessed political purpose.

"We believe the peoples throughout the world will join us in asking the Soviet Union not to proceed with a test which can serve no legitimate purpose and which adds a mass of additional radioactive fall-out to that which has been unleashed in recent weeks."

Rusk said the U. S. had received no assurances from Russia that the planned explosion would not hurt inhabitants of this country. He said "one possibility" is that Russia will seek a new moratorium after completing its current series of tests, adding that such a moratorium "would not be a very productive enterprise."

The Secretary of State declined to elaborate on previous statements by President Kennedy on whether the U. S. would resume nuclear testing in the atmosphere. The President Oct. 11 said the Russians "have made over 20 tests in the atmosphere, and we have to make a judgment as to what is in the best interests of our security, and that is a matter which is being studied. For the present, our tests are underground, and we feel that is in accordance with our security."

He also said if Russia at the end of its current tests proposed a test ban, "that would not be very helpful in view of the experience we have gone through this year."

General reaction of world leaders to the bomb test announcement was one of dismay, coupled with the theory the blast was designed to frighten countries outside the Iron Curtain. Sen. Clinton P. Anderson (D.-N. M.), former chairman of the Joint Congressional Atomic Energy Committee, said the 50-mega-

ton explosion "will have serious fallout implications. I hope," he added, "that we don't get into that kind of race with the Russians."

Khrushchev did not specify where the 50-megaton bomb would be exploded or how. One theory is that the Russians plan to use a multi-stage rocket they have been testing recently to carry the bomb high above the earth for detonation.

Tass, the Russian news agency, said Russia on Oct. 13 fired a multi-stage rocket "over a distance of more than 12,000 kilometers (7,452 miles)" and it "followed strictly the prescribed program."

Khrushchev also said the Soviets are building up a nuclear-powered submarine fleet equipped with ballistic and target-seeking rockets. He said the submarines are capable of attacking ocean-going ships hundreds of kilometers away.

Vice President Asks More Liaison Between Civilian-Military in Space

New York—Indications of a new, clear-cut Administration policy on space, that would fuse military and civilian programs into a tightly-coordinated, highly-cooperative national effort, were given by Vice President Lyndon B. Johnson in a speech presented to the recent American Rocket Society meeting here.

"It is not useful to pretend that arbitrary distinctions can or should be made between the two," Johnson said, referring to the military and civilian space programs. "The same engineering, the same scientific knowledge, the same values of man in space are applicable to defense and non-defense objectives.

"The liquid-fueled rockets from our IRBM and ICBM programs, as well as the solid fuel technology developed in the Polaris and Minuteman programs, all have become a part of the national space effort."

The Vice President said that while American policy has been and will continue to be that space is for peaceful purposes, "the present world situation allows us no choice—we must have a military as well as a civilian space capability."

Although giving the military services encouragement for a greater role in space, Johnson is said to be insistent that the National Aeronautics and Space Administration remain the major U.S. space agency and that USAF and NASA blend their programs into complementary—not competitive—efforts.

"The future of this country and the welfare of the free world depend upon our success in space," Johnson said. "There is no room in this nation for anything but a fully cooperative, urgently motivated all-out effort from all of us toward space leadership.

"No one person, no one company, no one government agency has a monopoly on the competence, the missions or the requirements for the space program. It is tonight, and it must continue tomorrow, to be a national job for all Americans, wherever they live, whatever they do, whatever political party they belong to."

The Vice President also called on all members of the United Nations to "join with us in making at least a brave start in dedicating outer space to the blessings of space." Describing space as having the potential for "dangers of a new and sinister kind," Johnson said that the control of, and cooperation in, space can be expanded as experience shows that confidence grows among nations that each is genuinely interested in peace. "But," he warned, "we cannot wait indefinitely with impunity."

"Time presses, suspicions multiply, anxieties accumulate and opportunities vanish," Johnson said. "The necessity of an international agreement becomes more important and more difficult as our advances into space become bolder and more venturesome."

ARS Honors Nine For Space Endeavors

New York—Nine government, industry and university representatives were honored by the American Rocket Society during its recent meeting here for their achievements in space science:

- **Dr. Wernher von Braun**, director of the National Aeronautics and Space Administration's Marshall Space Flight Center; the Dr. Robert H. Goddard memorial medal for "general eminence in the field of rocket engineering and space flight."
- **Cdr. Alan B. Shepard**, Mercury pilot; the Astronautics medal for his flight aboard Mercury-Redstone 3 last May 5.
- **Harrison A. Storms, Jr.**, president of Space Information Division, North American Aviation; the James H. Wyld memorial medal for "outstanding applications of world rocket power."
- **Robert B. Young**, vice president and general manager of Aerojet-General's Liquid Rocket Plant; the Propulsion medal for "contributions to rocket propulsion over the past two decades and, specifically, for his efforts in the development of the Titan II engines."
- **Krafft Ehricke**, Centaur program director, General Dynamics/Astronautics; the Dr. G. Edward Pendray medal for "outstanding contributions to astronautical literature."
- **Dr. James Van Allen**, professor and head of the department of physics and astronomy, State University of Iowa; the Research medal, donated by Douglas Aircraft Corp., for basic research in astronomics and rocketry.
- **Ronald H. Winston and Franklin J. Kosden**, Harvard University and Massachusetts Institute of Technology respectively; undergraduate student medals.
- **Bengt U. O. Sonnerup**, Cornell University; the graduate student medal.

Webb Credits Kennedy With Space Advance

New York—Kennedy Administration action in funding the U.S. space program will result in accomplishing in 10 years what would have taken 15 years to do under the Eisenhower Administration, according to James E. Webb, administrator of the National Aeronautics and Space Administration.

Webb said the Eisenhower budget would not have permitted manned lunar landings until 1975, despite the buildup in space which had been started in 1958. New U.S. goal for manned lunar landing is 1967. He said President Kennedy views the space program "as not solely scientific or technical, but as . . . [a part of] broad national and international policy. . . ."

The President, Webb said, "has often expressed a strong feeling that the ability of the U.S. to achieve its great international goals of peace and fulfillment for all mankind depends to a large degree upon what we can achieve in space."

Webb said the President quickly decided to accelerate large boosters and Apollo, and to recognize the potential of the National Aeronautics and Space Council to carry out "major new goals for the nation in space and new programs to achieve them."

Speaking at the Twentieth American Assembly meeting in Harriman, N. Y., Webb credited his predecessor, Keith Glennan with "organizational work and careful studies" leading to the current reorganization of NASA (AW Oct. 2, p. 32). The inference was clear, however, that Eisenhower failed to appreciate the full potential of an active space program.

"The policy of the present Administration," Webb said, "is to press forward in all related areas of science and technology at the most rapid rate that can be justified without involving the wastefulness of crash programs."

NATO V/STOL Fighter Revision Urged

By Cecil Brownlow

Paris—West German government, with air force backing, is insisting upon a revision of the performance specifications for the North Atlantic Treaty Organization's planned V/STOL close-support strike reconnaissance fighter, possibly splitting the program into two specific types of aircraft, before lending final approval and financial support.

The West Germans, who are being counted upon to absorb a major share of the approximately 1,500 V/STOL fighters that have been tentatively projected for the common European production program, have told NATO headquarters here that any aircraft must have a greater on-the-deck speed than now called for plus the capability of performing a supersonic interception role if it is to meet that country's needs.

The NATO specifications, distributed last summer and with a present design proposal deadline of Dec. 31 for interested companies, specify a minimum on-the-deck performance of Mach .92 for a distance of at least 250 mi. In response to earlier demands from several quarters that greater speed is needed, however, a covering letter stated that anything beyond this would be welcome.

The West Germans have said in the past that they want three distinct aircraft to meet their defense needs in the V/STOL area—a high-performance, high-altitude fighter as a late-1960s replacement for the Lockheed F-104G, a close-support fighter as a successor to the Fiat G. 91 and a medium-range transport to support the combat planes at their dispersed sites (AW Dec. 5, p. 72). They apparently are now returning to this belief and are unwilling to accept, for the moment, the present NATO proposal.

German Plan

The German plan submitted at a recent NATO meeting was interpreted in some industry quarters as tantamount to a walkout, or a serious threat of one. The West German Defense Ministry emphasized last week, however, that "under no circumstances have we walked out." A Ministry spokesman, who declined to discuss any proposed changes in the specifications, said only that "we have to work in our technical fields along the lines of what the nation needs for its defense," adding that "the whole thing is now being discussed" within NATO.

"We are still interested in it [the NATO program]," he said. "We have submitted our specification (needs), and now they are up for negotiations with the others involved." He conceded, however, that, if they are not adopted, the West German government may be forced to take another look as to the extent it will participate in the NATO program.

If the specifications are changed, or if there is any lengthy debate over whether they should be, a number of observers here believe that the present Dec. 31 deadline proposals may be missed by a substantial margin.

There is some feeling here that the Germans could have achieved substantially what they want without insisting upon revised specifications and possibly two types of aircraft, relying instead upon the better performance qualification contained in last summer's covering letter.

Such reliance, however, would be admittedly tenuous, and NATO officials have said in the past that they plan to adhere closely to the specifications as laid down by multi-nation agreement in any selection of a design as a common V/STOL strike reconnaissance fighter.

Team of Technicians

The German plan for a high-speed interceptor appears to generally follow the performance parameters of the V/STOL design begun approximately three years ago in Munich by a team of technicians pooled from Messerschmitt, Heinkel and Bölkow and headed by the former concern's Dr. Robert Lusser.

Now designated the VJ-101 and built around the concepts of the Bell D-188, the project originally envisioned a V/STOL interceptor with speeds of up to Mach 3. It was later reoriented to fit the NATO specifications more closely, retaining, however, a substantial intercept capability (AW June 5, p. 30). Vertical thrust is supplied by four 6,000-lb.-thrust Rolls-Royce RB. 162 turbojet lift engines mounted in each of two vectoring wingtip pods.

First flight of the prototype is currently scheduled for sometime next year. Northrop, Inc., is providing technical assistance in laminar flow techniques and aiding in the design of the aircraft's weapons system package.

A second German approach, one which could fit the G. 91 replacement requirement, is under consideration by Focke-Wulf with major reliance upon Britain's Hawker Aircraft, Ltd., and a follow-on version of the transonic Hawker Siddeley P. 1127 tactical fighter, which is now in the flight evaluation stage.

Proposed follow-on version would be powered by an improved 27,500-lb.-thrust development of its Bristol Siddeley BS. 53 lift-thrust turbofan engine which powers the 1127. The powerplant installed in the 1127 has a present thrust rating of about 12,500 lb., but its projected capability is approximately 18,500 lb.

Firm negotiations between Focke-Wulf and Hawker, begun at the time of the Farnborough air show (AW Sept. 11, p. 27), were still under way last week, with the final details and scope of participation still undecided. A

Changes Bar TFX From Some Carriers

Changes in the wording of specifications for the TFX tactical fighter would make the aircraft incompatible with so-called 27C angled deck conversions of Essex class aircraft carriers which the Navy had insisted must be able to operate the twin-engine plane.

The changes were revealed to prospective bidders at a conference at the Aeronautical Systems Division, Wright-Patterson AFB, last Monday. Changes ordered by Defense Department officials would provide for emergency landings only on the 27C class ships. Thus the aircraft will be longer and heavier than the 56 ft. and 55,000 lb. the Navy had wanted.

Of 15 attack aircraft carriers now in operation, seven are in the 27C category, three are the larger Midway class and five are the even larger Forrestal class. The latter two ships could operate the TFX. Another Forrestal class carrier, the Constellation, will join the fleet soon and the nuclear powered carrier Enterprise will become operational next year.

Program packages as approved by the secretary of defense provide for beginning construction of a conventionally powered carrier every other year. Defense Department officials consider this sufficient to maintain a normal force level of 14 attack carriers able to operate the TFX from the late 1960s on.

Air Force believes the TFX can become operational by 1966. Navy says 1968 is more realistic, maintaining that too many innovations such as the variable geometry wing have to be developed. Air Force counters this by saying that all new principles involved in the specifications have been proved through applied research, including thousands of hours of tests in wind tunnels.

British spokesman said, however, that an agreement appeared imminent. Basic design of the aircraft itself is complete.

It is doubtful, however, that proposals with heavy German interests could be chosen to fill both missions—if such a route is agreed upon—because of the sometimes-severe political consideration already surrounding the program in which each nation is demanding its share of prestige and recognition.

The plan also probably will meet with firm opposition from the smaller NATO nations with limited finances and no money to spread across two different types of aircraft and their related follow-on costs.

Other competitors in the strike fighter competition – potentially the largest financial boon for the West European industry for the next several years—include a variable sweep Republic-Fokker proposal with an on-the-deck design speed of Mach 1.25 (AW June 5, p. 30) for distances of over 300 mi., the Dassault-Sud Balzac based upon the Mirage 111 fuselage and the Fiat G. 95, a direct descendant of the G. 91 and largely a paper project.

In France, Nord Aviation also has been working on a design using an advanced version of the BS. 53 as its powerplant, but the planned official French entry is the Balzac, which obtains vertical lift from four fuselage-mounted RB. 162s.

Another possible late entry may come from Ryan Aeronautical Co. with a design study based upon its experience with the X-13 research vehicle. Ryan recently established a European sales office in Paris.

A model of the Republic-Fokker design is now being wind tunnel tested in The Netherlands to collate and verify earlier results computed by the National Aeronautics and Space Administration and by Republic. All speed regimes had been explored in tests completed by late last week, and a Fokker spokesman said the results thus far have been "very satisfactory." Powerplant is the Bristol Siddeley BS. 100, a 38,500-lb. thrust follow-on to the BS. 53, with afterburners installed in the two forward plenum chambers.

Recently named program manager for the project is Alexander Wadowsky, former manager of advanced weapons systems of Republic's Scientific Research Department.

The paralleling NATO competition for a medium-range V/STOL transport to support the reconnaissance fighter, a project that fits into current German thinking, also is drawing new interest.

At least two U. S. firms—Douglas Aircraft Co. and Vought Aircraft Corp.—are planning to sponsor prime proposals with associated European firms. U. S. associates with Vought in the project are Ryan and Hiller Aircraft Corp.

The Vought entry will be essentially the same as the tilt-wing design, powered by General Electric T64 turboprop engines, that has been recommended to Defense as the tri-service VTOL transport by the military selection board (AW Sept. 4, p. 36).

Both Douglas and Vought are now working to line up European partners, a necessity since consortium European production is planned, primarily in France. Italy's Piaggio, however, may also join the Douglas team.

European entries also are expected from two West German firms—Focke-Wulf and Dornier. The Focke-Wulf design incorporates a total of 12 Rolls RB.162s in two wingtip pods (AW June 5, p. 30). Dornier is working with Bristol Siddeley on a transport deriving both vertical and horizontal thrust from a BS. 100 podded underneath either wing.

Ground rules and specifications for this competition, with a Nov. 15 deadline for submission of design studies, are looser than those now in force for the strike reconnaissance fighter.

Kiwi B Reactor Testing Program Will Result in Firm Nerva Design

Washington—Kiwi B nuclear rocket research reactor tests during the next 12 months will solve the basic unknowns remaining in the design of the Nerva nuclear flight engine, according to Harold B. Finger, director of the joint Atomic Energy Commission-National Aeronautics and Space Administration Space Nuclear Propulsion Office.

Kiwi B tests, to be conducted with a down-firing reactor at Jackass Flats, Nev., are expected to provide data on operations at high temperature, radiation and stress loads, and information on power densities, use of liquid hydrogen, and rapid start, shutdown and restart.

Finger said the Nerva engine could be flown in 1966 or 1967, and if there are no technical difficulties, a 1965 flight date is possible. With an output of 1,000 megawatts, Nerva will produce a thrust of about 50,000 lb. and is considered a flying test bed by NASA. The agency anticipates that an operational nuclear engine stage for manned space flight will be four to five times as powerful as Nerva.

Speaking before the National Rocket Club here, Finger said chemical propulsion "does not appear feasible beyond the manned lunar landing mission."

He said that although the U. S. is driving hard to beat Soviet Russia to a manned lunar landing, we "may not win, so we must be prepared for the next mission"—flights to Venus and Mars, and a manned outpost on the moon.

All launch vehicles under consideration for the lunar mission, he said, are being reviewed on their adaptability to accommodate nuclear upper stages for these advanced missions.

Finger said a contractor will be selected early next year to develop and build the reactor inflight test (RIFT) stage which will be propelled by the Nerva engine. Nerva is being developed by a team of Aerojet-General, Westinghouse, Bendix and American Machine & Foundry Co.

Other developments in the nuclear rocket program summarized by Finger:

- **Second RIFT** test stand is to be developed at the AEC's Nevada test site, and the first stand is under construction. Requests will go to industry soon for the superstructure for the first. Architectural and engineering bids for the second stand were received by the joint nuclear office last Wednesday.
- **Kiwi A test series** provided basic data on design concepts, fuel element fabrication and fuel element corrosion by hydrogen. These tests were conducted in 1959-60.
- **Relationships** with the Defense Department have some deficiencies because the Air Force no longer has a permanent propulsion representative in AEC. However, USAF was represented on the Nerva source selection board, and there is an exchange of information through the propulsion group of the Aeronautics and Astronautics Coordination Board.
- **Management** relationship gives Finger day-to-day executive responsibility for over-all development of the nuclear rocket system. AEC's Los Alamos office directs reactor development, and the joint AEC-NASA nuclear propulsion office in Cleveland, Ohio, manages the Nerva engine industrial team. NASA's Marshall Space Flight Center will manage Nerva stage development and launch the flight engine, probably as second stage of a Saturn C-1 vehicle.
- **Aircraft nuclear** propulsion program made a vast contribution to the nuclear rocket program by providing tools of design and analysis, design techniques, and by training people who now are dispersed throughout the nuclear industry.
- **Re-entry information** is still lacking in the nuclear field, and data is being sought in controlled impact, pulverizing the complete system or pulverizing the reactor core of nuclear rockets placed in orbits which decay.

Only Seven Companies Bid for Saturn S-I

Washington—Only seven contractors submitted proposals to fabricate and assemble the Saturn S-I booster stage, apparently because a large number of other potential bidders have decided to try for much larger vehicle, spacecraft and engine contracts which the National Aeronautics and Space Administration will award before the end of the year.

Bidders for the S-I booster are Avco Corp., Boeing Co., Ford Motor Co.'s Aeronutronic Division, Chance Vought Corp., Chrysler Corp.'s Missile Division, Northrop Corp., and Lockheed Missile and Space Co. A total of 37 companies was invited to bid.

Contract Award

The S-I contract will be awarded next month and is one of four sizable NASA projects which the agency hopes to place with industry before the end of this year. The others are:

- **Saturn S-IB** which includes development and test, as well as fabrication and assembly. NASA invited 27 firms to bid on this project (AW Oct. 16, p. 32), and bids will be due Nov. 8. Contract will be awarded sometime in December.
- **Apollo spacecraft,** also to be awarded in December. Five companies submitted proposals for this project Oct. 9 (AW Oct. 16, p. 27).
- **New Y-1** hydrogen-oxygen engine, to develop 1-1.5 million lb. thrust and probably propel the second stage of the Nova launch vehicle on a manned lunar landing.

For political reasons, NASA will not award any two of these contracts to the same company, and industry must play a guessing game to determine which of the large competitions to enter. Complicating the choice is the fact that NASA is seeking assurance that key personnel at all levels will be assigned to project management. Many companies feel they will jeopardize their chances for any contracts by bidding on all of them.

It also is likely that contracts will be spread geographically, since NASA believes it can gain wider acceptance of the expanding space program by dispersing its research facilities and manufacturing contracts throughout the country.

The Y-1 engine would be a conventional pump-fed, single-chamber hydrogen-oxygen system, five times larger than any hydrogen-oxygen engine now under development (AW Oct. 16, p. 23). Rocketdyne is developing the J-2 engine, which has a thrust of 200,000 lb. The only other hydrogen-oxygen engine being developed is the Pratt & Whitney LR-115 to power the Centaur stage in the Atlas-Centaur launch vehicle, and to be used for the Saturn S-IV stage. The J-2 will propel the S-II Saturn stage.

One concept for employment of the Y-1 engine is as the second stage of the liquid-propellant Nova vehicle. The configuration would consist of a booster cluster of eight F-1 engines, a second stage cluster of two Y-1 engines, and a third stage consisting of a cluster of four J-2s. Such a vehicle could lift 150,000 lb. into an escape trajectory, which would meet the Apollo manned lunar landing requirement.

Another proposal would be to use the C-4 booster, which consists of four F-1 engines, with a single Y-1 engine second stage and two J-2s as the third stage. This configuration would be used for rendezvous of the Apollo spacecraft and propulsion packages.

Although experience in the hydrogen-oxygen field is still very limited, Aerojet-General Corp., Pratt & Whitney Division of United Aircraft Corp., and Rocketdyne Division of North American Aviation, Inc., all have explored it both with company and government funds.

Unsolicited Proposals

Aerojet and Rocketdyne have submitted unsolicited proposals to NASA for a Y-1 engine, with thrust ranges of 1-1.5 million lb. Aerojet designates its engine AJ-1000. Rocketdyne has no official designation for its proposal, but refers to it as F-1H. This system would be a conversion to hydrogen-oxygen propellant of the 1.5 million lb. thrust F-1 engine, which uses kerosene and oxygen.

Meanwhile, first flight test of the Saturn S-I booster stage, scheduled for last Saturday, has been postponed at least a week to allow time for refinements in the vehicle control system. NASA said the changes, aimed at providing better test data, were made on the basis of static firings conducted at Marshall Space Flight Center. Data from the Marshall tests were being reduced while the flight vehicle, designated SA-1, was being prepared for launch.

NASA will build the first 11 Saturn S-I vehicles at Marshall, and the contractor who wins the coming award will build the remainder. At the present time, there are missions for 27 Saturn S-I boosters. One NASA official estimated that Saturn will have an operational life of six to seven years, and because of its high development cost, there will be a great incentive to continue to use it.

NASA headquarters has been impressed with the extensive preflight work done by Marshall, and with the success of preflight tests. All eight engines in the S-I cluster have been tested simultaneously more than a dozen times without a single failure.

The S-I stage eventually will be replaced by a cluster of F-1 engines, either two or four to a cluster, to boost Saturn C-3 or C-4 vehicles. Either the C-3 or C-4 will be developed concurrently with the Nova vehicle for rendezvous launches if this method is chosen for the Apollo mission.

Support Contracts

NASA recently awarded more than $26 million in contracts for engineering and manufacturing services in support of the Marshall Space Flight Center Saturn development program. Chrysler Corp. won contracts totaling $12.1 million; Hayes Corp., $7.3 million, and Brown Engineering Co., $7 million.

These contracts, for 12 months, will support vehicle construction being conducted in-house at Marshall.

The agency also awarded a $66,471 contract to Gurtler, Hebert and Co., Inc., to rehabilitate the old Michoud Ordnance Plant, which will be the production site for Saturn S-I and S-IB stages.

The rehabilitation project is to be completed in four months.

TAC-STRAC Becomes 'U.S. Strike Command'

Washington—Department of Defense has chosen the name "United States Strike Command" for the unified Tactical Air Command-Strategic Army Command force which was created last month (AW Sept. 25, p. 351).

Temporary headquarters for the new group's commander, Gen. Paul D. Adams, USA, is MacDill AFB, Tampa, Fla. The staff began functioning last Tuesday. This base is due to be deactivated but can provide sufficient facilities for the staff until permanent quarters can be located.

Gen. Adams and Deputy Commander Lt. Gen. Bruce K. Holloway have as assistant chiefs of staff the following officers: Brig Gen. Clifton F. Von Kann, USA, operations (J-3); Brig. Gen. Robert B. Neely, USA, logistics (J-4); Brig. Gen. Clyde Box, USAF, plans (J-5). Each assistant chief of staff is expected to be promoted to major general. Assistant chiefs of staff for personnel (J-1), intelligence (J-2) and communications (J-6) have not yet been appointed.

Justice Studies Carriers' Plan For Non-Profit Satellite Operator

Washington—Plan for a non-profit company to develop, construct and operate a commercial communication satellite system, proposed by an ad hoc committee of international carriers formed by the Federal Communications Commission, is now under study by the Justice Department, whose comments are expected next week.

Critics of the plan claim American Telephone & Telegraph Co. will dominate the system because it would provide most of the required capital, despite provisions which limit its representation on the non-profit company's board of directors to a decided minority.

The committee plan, to which Western Union dissented, calls for each carrier investing $500,000 or more in the non-profit company to have two members on its board of directors. In addition, there would be three public directors appointed by the President. U. S. carriers which do not invest but lease system facilities collectively would designate one director.

In response to an FCC request, five companies on the committee indicated they intend to invest in the venture while two others gave qualified indications of intent.

Not including directors who might be named to represent foreign communication agencies, the board would number between 14 and 18, of which only two directors would be appointed by AT&T.

On this basis, AT&T does not appear to have a dominant influence. But the proposed non-profit corporation would not itself own the satellites. Instead, companies contributing capital would have "undivided interest" in all the satellites, proportional to their investment.

Channel Capacity

Carriers authorized to use the system that need channel capacity greater than their proportionate interest, would pay rent to other carriers using less than their proportionate ownership share. The non-profit corporation would act as a clearing house for handling such bookkeeping.

The total capital available from the five carriers which indicated a firm intention to invest amounts to $77.8 million, of which up to $65 million would be put up by AT&T, representing 84% of the total, excluding any investment by foreign governments or agencies.

The question that the Justice Department, FCC, and perhaps in the final analysis, the President, must decide is whether the dominant capital investment by AT&T is more significant than its lack of dominant position on the board of directors.

There is a logical explanation for AT&T's much larger proposed investment in addition to the fact that the company is considerably larger than any of the other carriers. The voice communications which AT&T provides require approximately 20 times the bandwidth (channel capacity) of record/telegraphic services provided by the other carriers. Thus, if AT&T does not put up the bulk of the capital, it will be paying rent to other carriers for the use of their capacity.

If AT&T were to voluntarily limit its capital investment to the largest amount proposed by any other single carrier—$5 million—the total would be far from the $45 to $150 million estimated as necessary to build and place communication satellites in orbit. The only other alternatives would be government ownership or the formation of a publicly-owned "common carrier's common carrier," such as proposed earlier by General Electric and Lockheed.

Western Union, in its minority statement in the committee report, restates its previous contention that the satellites and the ground stations should be owned and operated by a public stock corporation. This would assure that ownership would be spread across a broad base "so that no one . . . could use its investment as leverage to influence the affairs of the corporation . . . ," Western Union said. Under the plan proposed by the majority, ground stations could be individually or jointly owned by individual carriers, or could be leased where smaller operators did not want to invest in their own facilities.

The report does not resolve the question of whether the space communication system should use large numbers of satellites in random, low-altitude polar orbit or a few in synchronous, equatorial orbit. "The choice . . . will be made in the light of the best information available from further research and development. . . . We expect that an operational system would be established initially by utilizing whatever satellite first proves most rewarding and then progressing to improved satellites in more difficult orbits as this becomes feasible."

The report says that limited commercial service via satellites may be possible by 1964 and an operational system may be in commercial service by 1965.

Initial investments required to establish an operable system for various configurations of satellites and orbit altitudes are estimated to be as follows:

- **$45 to $94 million:** 20 medium-altitude satellites in random polar orbit.
- **$50 to $100 million:** Two pairs of satellites in synchronous orbit.
- **$67 to $141 million:** 20 random polar orbit satellites plus 10 medium-altitude satellites in random equatorial orbit.
- **$75 to $150 million:** Three pairs of satellites in synchronous orbit.

The FCC has given interested carriers, companies and government agencies until Oct. 30 to submit comments or counter-proposals. Then the commission will decide whether to hold public hearings.

Chairman Russell B. Long (D.-La.) of the Senate monopoly subcommittee is expected to resume his hearings on the whole subject of the space communication system during the second week of November. Rep. Emanuel Celler (D.-N.Y.), chairman of the House anti-trust subcommittee and an outspoken critic of AT&T, has written to FCC Commissioner Newton N. Minow charging that the proposed plan would "afford AT&T clear dominance."

The National Aeronautics and Space Council, which originally developed the national policy on communication satellites announced by President Kennedy, is studying the committee report. It is not expected to take any action pending the FCC, Justice Department and congressional investigations.

Navy May Order 900 Drone Helicopters

New York—Navy probably will order about 900 torpedo-carrying drone helicopters for use aboard anti-submarine warfare surface vessels, Peter J. Papadakos, president of the Gyrodyne Co. of America, Inc., told the New York Society of Security Analysts last week.

Papadakos based his estimate on the Navy's announced intention to outfit 300 ships with rotary-wing drones. He said approximately three drones would be required for each ASW ship.

Not all of these aircraft necessarily will be Gyrodyne-made, Papadakos said, but he added that no other firm is known to be developing a helicopter capable of meeting the Navy's DASH (drone anti-submarine helicopter) requirements.

Gyrodyne currently is entering production of the DSN-3 drone, which is capable of carrying two nuclear acoustic homing torpedoes.

The drone is powered by a 270-hp. Boeing turbine engine.

Papadakos said the DSN-3 will cost approximately $100,000 each in lots of 50. Cost will include necessary avionic equipment to enable the craft to be controlled from a mother ship.

X-15/B-52 Studied as Blue Scout Boosters

By Russell Hawkes

Los Angeles—North American X-15 and its Boeing B-52 mothership could be demonstrated as recoverable booster stages for USAF's Blue Scout within nine months of the decision to go ahead and at a cost of $850,000, project officials announced.

The proposal is being made jointly by North American and by Ford Motor Co.'s Aeronutronic Division, prime contractor for the Blue Scout series of light, ground launched, solid propellant, space booster rocket systems. The proposal has been presented to officials of the Air Force Systems Command and Headquarters, USAF. Leaders of the program to use the X-15 as a recoverable booster for satellite payloads and high altitude probes said the service is still studying the plan.

North American and Ford officials only discuss scientific missions for the air-launched rocket system but the proposals to USAF included pure military missions. The system obviously has the ability to launch a ballistic warhead or put a short-term emergency communications relay in a high altitude ballistic trajectory. For such missions, the system could launch payloads weighing 600 to 800 lb. For orbital missions, the air-launched Blue Scouts are calculated to be capable of placing a 50 lb. payload in a 1,000-mi. orbit, 100 lb. in a 350-mi. orbit, or 150 lb. in a 200-mi. orbit. Escape velocity with payloads to 60 lb. may be possible in some cases.

Rocket stages may be either guided or unguided versions of the Blue Scout but most attention is being given to an unguided spin-stabilized system. It consists of a finned, Allegany Ballistic Laboratories X-259, an Aerojet AJ-10, and a spherical NOTS 100A final stage.

The spin motor is mounted in the interstage between the X-259 and the AJ-10. Ford officials are confident they can achieve precise orbits when this vehicle is launched from an X-15 despite the lack of a guidance system in the missile. For orbital missions, a spherical solid propellant final stage motor, probably somewhat larger than the NOTS 100A, would be reversed with the nozzle pointing in the opposite direction from the earlier stages. Stabilized by the vehicle's initial spin, it would be in a proper attitude to inject the payload into orbit after moving 150 deg. around the earth. Horizon scanners would be used to trigger the injection motor firing command.

Neither North American nor Ford see any difficulty in mating the Blue Scout with the X-15. Modifications to the X-15 and its B-52 carrier are expected to cost $350,000 and reconversion for missions other than rocket launching is said to be cheap and simple.

ARTIST'S CONCEPTION shows proposed utilization of North American X-15 as recoverable space booster system to launch two-stage Blue Scout rocket. The X-15 would separate from the B-52 mothership at an altitude of 50,000 ft., climb to 156,000 ft. and launch Blue Scout. No major X-15 modifications are anticipated by North American.

It would take about two and a half months for modifications to the two airplanes. Flight tests could begin several months from the go-ahead decision and would include the launch of a pair of inert dummy Blue Scouts and could be completed within two months.

Modification of the X-15 would include little more than the installation of the missile pylon and launch "trapeze," some additional wiring and cockpit installation, and the realignment of the X-15 engine thrust line two and a half degrees downward from its original position. This last change is necessary because the center of gravity is 11 in. lower and slightly farther aft when the missile is mounted. It enables the X-15 to operate at full thrust without introducing a change in pitching moment as it carries the missile upward.

Missile is launched at the instant the pilot shuts down the X-15 engine so there is no trim change due to thrust misalignment at the moment of launch.

Modifications to the B-52 would be limited to the addition of some missile checkout functions to the X-15 launch and checkout equipment already aboard. (See AW Aug. 28, p. 72 for B-52 first stage booster proposal.) When the X-15 is hung under the wing of the B-52, the ground clearance is large enough to accommodate the Blue Scout under the X-15 without any difficulty. Little if any part of the rocket would extend below the tip of the airplane's ventral fin.

Unguided, air-launched Blue Scout would weigh roughly 4,200 lb. and its launch pylon would weigh another 500 lb. A North American official said X-15 performance will still be ample for the mission with this extra weight aboard.

North American test pilot Al White says there is no reason to anticipate difficulty at separation of the missile from the airplane. Despite the 2,800 mph. airspeed at the moment of separation, the dynamic pressure will only be about 20 psf. at the probe's launch altitude of 156,000 ft.

If the rocket should fail to ignite successfully, it would already have been jettisoned along with the launch rails at the bottom of the extension stroke. The jettison operation would be de-energized as the missile leaves the launch rails if ignition is successful and the launch rail would be retracted into the pylon. Spin motor ignition would be delayed a moment after launch to prevent damage to the airplane. It would not start at all if the first stage propulsion motor should fail to start.

Ford and North American claim that the combination of the B-52 and X-15 as boosters with Blue Scout upper stages can save $12 million on 50 launches or $24 million on a hundred launches during a two and a half year period.

The figure for 100 launches is based on the modification of two X-15s. If the proposal should be accepted and expanded, North American officials say that a new X-15 could be made for $7.8 million.

Saint Subcontractors

New York—Major subcontract selections for USAF satellite inspector program, formerly called Saint, were announced late last week by Radio Corp. of America, system prime contractor for design, fabrication and testing:

- Aerojet-General Corp., propulsion system and associated ground equipment.
- Minneapolis-Honeywell, guidance system.
- Avco Corp., structure and interstage.
- Westinghouse Corp. and Emerson Electric Co., radar systems.
- Garrett Corp. temperature control unit.
- Douglas Aircraft Co., vehicle fairing.
- Applied Design Co., ground handling and erection trailer.

X-15 Flies 3,920 mph., Heating Nears Limit

Edwards AFB, Calif.—A record speed of 3,920 mph. was attained Oct. 17 in the X-15 by Test Pilot Joseph A. Walker of the National Aeronautics and Space Administration. Six days after the number two X-15 was pushed to a record altitude later confirmed at 217,000 ft., Walker flew the number one aircraft to Mach 5.78 at an altitude of 102,000 ft. Maximum recorded aerodynamic heating of 1,100F was near the design limit of 1,200F.

Daddario Sees Change In NASA Patent Law

Washington—House Science and Astronautics Patents Subcommittee will recommend that Congress revise the National Aeronautics and Space Administration patent law to enable NASA to relinquish title to inventions made by private contractors.

Subcommittee Chairman Emilio Q. Daddario (D.-Conn.) said last week during celebration of the 125th anniversary of the American patent system that the present law reduces the incentive of contractors to make and disclose inventions, thereby producing "a boomerang effect" which discourages contractors from doing the research vital to the space program.

Under the 1958 Space Act, NASA must take title to inventions made by contractors while executing a space agency contract. Rep. Daddario said NASA should have the choice of keeping title to the invention or giving it to the contractor. He said his subcommittee expects to make that recommendation in the report to be issued after the final round of patent hearings, scheduled for Dec. 4 through 7.

New Soviet Helicopters

Two new helicopters, the V-2 and the V-8, produced by the Mikhail Mil designing office, have been announced by Russia. Both were developed from the earlier M-1 and M-4 types and share many common parts.

The V-2, which is powered by two light gas turbine engines, can carry eight passengers and 150% more freight than the M-1, which was powered by one reciprocating engine. It will be used for general utility work such as crop spraying and by local airlines. The V-8 will carry 20 passengers and two tons of freight.

Russia Says E-166 Set World Speed Record

Moscow—Soviet Russia has claimed a new world speed record over a 100 km. closed course of 1,482.039 mph. which it said was set Oct. 7 by a single-seat, delta-winged E-166 fighter. Russia has not used this designation before and did not identify the aircraft further.

Russia also said the Federation Aeronautique Internationale had approved a world altitude record of 113,896 ft. set last April by an E-66A turbojet piloted by G. Mosalov. This is the first time Russia has added the letter A to the designation for the E-66, which is believed to be a Mikoyan delta-wing fighter. The altitude figure is 1,602 ft. higher than the claim originally made for the flight (AW Sept. 11, p. 26).

Russia also claimed two records for the Kamov Vintokyrl convertiplane first unveiled at the Tushino air show last summer (AW July 17, p. 31).

The speed record claimed for the E-166 was set by Alexander Vasilyevich Fedotov, who flew a rocket-assisted turbojet fighter at Tushino, Russia said. No claim was made that the record was set with the same rocket-boosted aircraft, however. Soviet publications said the aircraft reached speeds of 1,696.412 mph. over some sections of the course and said it actually gained 13,000 ft. in altitude as it flew the course.

Russia said the convertiplane set a record of 227 mph. over a 15-25 km. course on Oct. 7 on a 30-min. flight and reached top speed at 4,900 ft.; and a record of 227 mph. on the 100 km. closed course on Oct. 12, reaching speeds of 233 mph. over some stretches. This exceeds the previous record of 190.77 mph. held by the British Rotodyne, Russia said. The convertiplane is powered by two turboprop engines of 5,700 hp. each. All record claims have been forwarded to FAI for certification, Russia said.

News Digest

First German-built Lockheed F-104G and Fiat G.91 aircraft have been handed over to West German air force.

USAF/Kaman H-43B turbine-powered helicopter was flown to an altitude of 32,000 ft. last week, claiming a world record for Class E-1D helicopters (3,858 to 6,614 lb. gross weight). Flight set a U. S. record for all helicopters, exceeding the 29,777 ft. altitude reached by a Cessna YH-41 in 1957. The H-43B flown was the same aircraft which set a world altitude record of 26,369 ft. for helicopters carrying a 1,000 kg. (2,204 lb.) payload last May 25.

Curtiss-Wright Corp. rejoined the Aerospace Industries Assn. last week, two years after resigning from AIA on a decision by firm's former management.

Micro-miniature digital computer, weighing only 10 oz. and occupying 6.3 cu. in., has been constructed from semiconductor networks by Texas Instruments under Aeronautical Systems Division sponsorship.

Gerhard Neumann has been appointed general manager of the General Electric Co.'s Flight Propulsion Division, succeeding Neil E. Firestone, who has been assigned to the firm's Project Apollo team. David F. Shaw was named general manager of the large jet engine department, and Edward Woll was appointed general manager of the small aircraft engine department.

Three Pratt & Whitney senior engineers have been appointed assistant chief engineers at the company's East Hartford, Conn., facility. They are Edmund D. Brown, advanced power systems; William H. Sens, advanced jet systems, and Frank T. Sprogell, Jr., production.

Discoverer XXXII was launched from Vandenberg AFB, Calif., and was recovered by air snatch after its 18th pass.

Robert F. Hurt was elected president of Grand Central Rocket Co. last week succeeding Burt C. Monesmith. Monesmith, a vice president of Lockheed Aircraft Corp. which recently acquired complete ownership of Grand Central, had been serving in the position temporarily. Hurt had served as Grand Central vice president-operations since last June and previously was in charge of F-104 manufacture at Lockheed. Hurt and G. R. Makepeace, Grand Central vice president-research and engineering, were elected to Grand Central's board.

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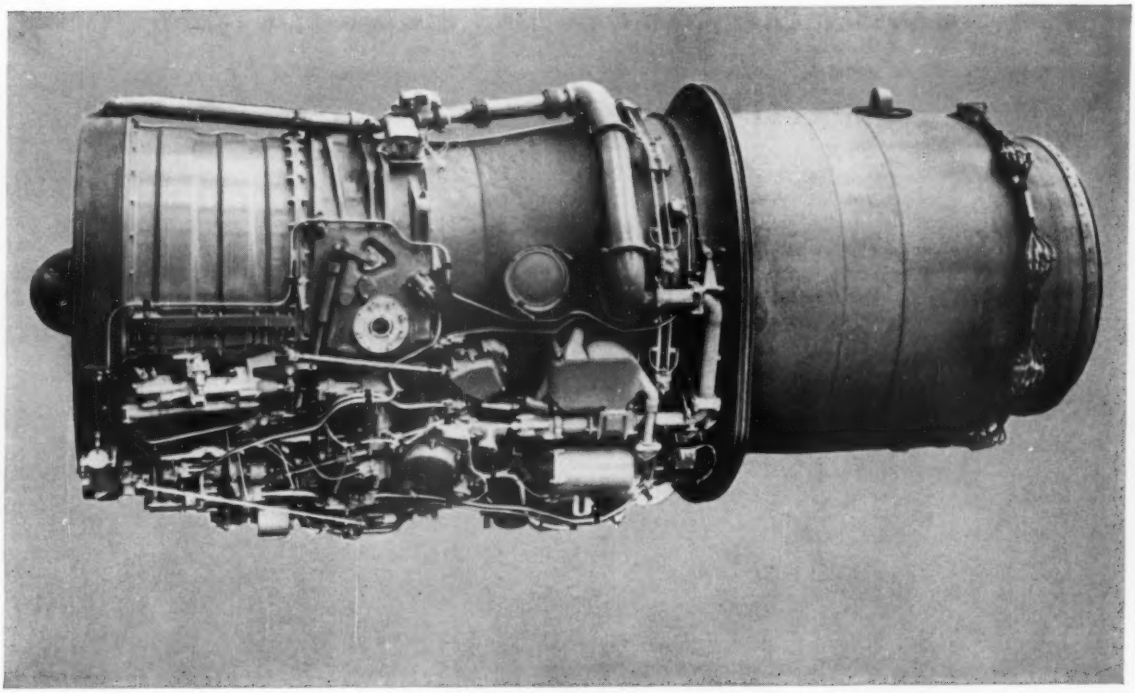

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IATA Delegates Strive to End Dissension

International carriers' meeting faces conflicts over fares, bilaterals; small airlines to bid for strength.

By L. L. Doty

Sydney, Australia—International Air Transport Assn.'s 17th Annual General Meeting opened here today with delegates determined to restore a unity that has been shaken during the past two years by a controversy over rates and a bitter struggle for control of the powerful executive committee.

Behind these issues lies another problem, which—although outside the province of IATA—is placing a new strain on large carriers with a strong hold on executive committee memberships: The quarrel between U.S. and smaller European airlines over the capacity restrictions of bilateral agreements. Whether IATA will overcome these problems with any show of strength will be put to test later this week when nine new vacancies on the 18-man committee are filled.

At last year's meeting in Copenhagen (AW Sept. 12, 1960, p. 40), several small carriers made a strong move to fill vacancies with representatives from their ranks. It failed only because Sir William Hildred, IATA director general, kept a firm hand on the balloting procedure. No nominations were accepted from the floor and only delegates nominated by the executive committee were elected to the committee.

Small carriers won one concession, however. It was agreed in Copenhagen that nominations for this year's election would be accepted by mail. Only one mail nomination has been submitted—that of Richard Jackson, president of Seaboard World Airlines.

Observers here feel that Jackson will not win the post since three American carriers—Braniff, Trans World Airlines and Pan American—already are represented on the committee and there is fear that a fourth would upset the balance of national representation.

Nine Seats Open

Normally, there are only six vacancies each year on the committee, but with the resignations of Ake Rusck of Scandinavian Airlines System and Seijiro Yanagita of Japan Air Lines, and the death of Max Hymans of Air France, there are nine openings for the first time in IATA's history.

Of nine incumbent members, four will be absent from this year's meeting: Warren Lee Pierson of TWA, Gordon McGregor of Trans-Canada Air Lines, Lord Douglas of Kirtleside of British European Airways and Sheik Najib Alamudin of Middle East Airlines. As a result, only five members will be on hand to protect committee strength.

There is talk here that dissident carriers may try to unseat Hildred. The firm conviction among smaller carriers that they are submerged into obscurity by Hildred and a hard core of the executive committee has not subsided since last year's meeting. However, Hildred holds loyal support of the five committee members attending, including Pan Am, which has always played a dominating role in IATA affairs.

Small carriers may get a foothold this year through a possible break between U.S. and European airlines represented on the committee. These airlines—which together hold ten seats on the committee with only two open for reelection—have been battling over bilateral issues for close to two years. This, coupled with wide dissension over rate structures, could weaken the solidarity that has helped the group to retain its power since IATA was formed immediately after World War II.

The majority of problems facing IATA this year can be traced to excessive seating capacity. Excessive capacity is a prime reason for the industry's financial dilemma: The high cost of operating an expanding volume of available seat miles at load factors well below the break-even point.

The U.S. attempt to restrict capacity of foreign flag carriers serving U.S. gateways is the real reason behind the mistrust foreign airlines hold for the U.S. in bilateral negotiations. The capacity problem has also brought on repeated drives for lower fares, but these attempts are consistently frustrated by disagreement over minor provisions (AW Aug. 7, p. 36).

Hildred stressed the significance of expanding capacity in his opening remarks here today. He noted that 10% more passenger flights were scheduled on North Atlantic routes during the first six months of 1961 than had been during the same period last year, and that seating capacity expanded 47% while load factors fell 16 points in the face of a 12.3% increase in traffic.

Market Expansion Urged

There is cause for "concern" over the problem, he said, but no need for pessimism. He urged the airlines to expand their markets, describing the industry as primarily a public service but one that is becoming "more and more a consumer industry." He added:

"The largest, though not necessarily the most important part of our traffic, already depends, not on the people who must go somewhere, but on those who must be persuaded to go." In this connection, he noted that if the airlines had filled all their capacity in 1960, the world would not have had enough hotel beds to lodge all the tourists.

In a move to ease the friction over bilateral agreements, Hildred said:

"The past year has been notable for a series of government negotiations on bilateral agreements which, in many cases, have ended in stalemate and even acrimony.

"They are not IATA's business, but their result and even their atmosphere are bound to have some effect on our work."

In an obvious reference to the U.S. stand on control of capacity, he said, ". . . it is a mistake of policy to approach these matters on the basis of who carries what share of which traffic now." he added:

"Obviously, no one is making a fortune carrying today's traffic. This preoccupation with the way to split a little apple and look at the pips will only divert attention from the common objective of governments and airlines alike to increase the size of the market, to grow a bigger apple so that everyone can have a good bite."

Since the U.S. Civil Aeronautics

Panair Orders Caravelles

Paris—Panair do Brasil, Brazilian airline, has ordered four Sud Caravelle IV.Rs for delivery in the spring of 1962. The South American airline also took an option on two additional Caravelles.

The new order brings Sud Aviation's Caravelle backlog to 146 firm orders plus 50 options.

Board partly on the urging of U. S. international carriers, has already publicly stated its intention to protect U. S. airlines against foreign competition, Hildred's plea and advice are not likely to go far in resolving the bitter feelings between the two airline groups.

As in the past, inability of IATA member airlines to reach agreement on a proposed rate reduction is another major issue here. Two unsuccessful attempts to arrive at unanimous support for a reduced promotional fare, followed by a mail vote on a Pan American proposal (AW Oct. 2, p. 36), have left the industry split on the issue.

Most carriers want the group fare and several informal compromise moves have already been made here to reach some settlement. At least one small carrier might be able to bargain its way into membership on the executive committee by dropping its objection to the group fare, as a result of these off-the-floor talks.

Hildred made no specific reference to the group fare in his report to the meeting. He did call for lower fares expressing the hope that the "aircraft would become the vehicle of the factory hand's holiday." He added:

"The 17-day North Atlantic excursion has produced good results, but it is not enough. The interest in charters has produced new traffic, but it is not a healthy development. Charters are a useful means of employing traffic in the off-season, but charters in the high season could well be suicidal."

Supersonic Discussion

The supersonic transport was also expected to be a major topic during the meeting. The IATA Technical Committee is slated to devote a substantial portion of its report later this week to the transport.

This report will urge that the development be inter-related with the present development of air transportation. It will point out that many problems visualized for the transport are problems which face the industry today in the operation of subsonic jets. It will also warn against allowing optimistic prospects of the supersonic transport to jeopardize normal fleet expansion and operating improvements.

Hildred voiced no optimism over the supersonic transport in his report today. He expressed these fears:

• **Supersonic transports,** of any type, will be expensive beyond all previous experience. It will be beyond the capability of either airlines or manufacturers to finance their development.

• **The effect** of sonic boom and noise restrictions on supersonic transport operations is still unknown. He also warned: "If the jet has produced overcapacity, the supersonic transport could flood the world with it."

• **Governments** have acknowledged that public financing of supersonic transport development will be a necessity but have indicated a wish to recover their investment through the selling price to the operator. "A purchase price for the supersonic transport which will reflect full cost of its development must . . . produce an inordinately high fare" which would force the industry back on public subsidy, Hildred said. Governments which decide to build a supersonic transport should face the full consequences of that decision, he said. "If they want prestige, they must be prepared to pay for it. There will not be enough airlines and enough passengers to pay for it," he said.

Airlines 'Healthy'

In his report on the state of the industry, Hildred declared the airlines "essentially healthy and resilient" with troubles of a temporary nature. He reported financial estimates compiled by the International Civil Aviation Organization for 1960 showed that the airlines of the world (scheduled airlines of all countries except the USSR and the People's Republic of China) had operating revenues in 1960 of $5.5 billion. This compares with operating expenses of $5.44 billion. Operating margin for the year was $57 million which gives the industry a 1% operating margin before taxes, interest, dividends and other charges. Hildred called this margin "ridiculous" and warned that such results cannot be "allowed to drag on year after year. . . ."

Passengers Increase

During 1960, Hildred said the world's airlines carried a total of 106 million international and domestic passengers, breaking the 100 million mark for the first time. International traffic totaled 23 million, a 24% increase over 1959. Domestic traffic reached 83 million, a slight 6.4% increase.

Hildred blamed the poor showing in the domestic field to the lack of growth of U. S. traffic, which accounts for the largest part of all domestic traffic. Number of passengers carried by U. S. domestic airlines reached 52 million, a 2% increase over the previous year, according to ICAO estimates.

Hildred reported that, at the end of 1960, IATA members had 3,376 aircraft, consisting of 382 turbojets, 480 turboprops, 2,477 piston-engined airplanes and 37 helicopters. In 1960, there were 103 fewer aircraft in IATA member fleets than in 1956, a drop of 3%.

Flight Engineers Charge Attempts To Hamper Their Accident Probers

Washington—Flight Engineers International Assn. last week accused the Air Line Pilots Assn. and some airlines and manufacturers with hampering the union's accident investigation.

Congressional legislation to remove these "pressures" will be sought during the next session, Glenn B. Iverson, technical vice president of FEIA, stated in a letter to the union's 130 accident investigators.

Iverson emphasized that accident investigation, conducted as an aid to the Civil Aeronautics Board, consumes 20% of the union's operating budget. He reviewed a series of incidents which he claimed were examples of pressures brought to bear on Civil Aeronautics Board in an effort to prevent participation of the engineers' union in investigations.

"In recent months we have had men assigned to more than three fatal crashes simultaneously," he said. "One of these men was threatened by an airline with loss of his job if he did not drop a particular line of questioning, and another has been told by a manufacturer, who was becoming embarrassed by the investigation, that the manufacturer would seek a way to design the flight engineer off future airplanes by cockpit changes if the line of investigation didn't halt.

"In addition to this," he continued, "we have been barred from being parties to two investigations, which means of course that we cannot see the official documents compiled in the investigation, because of pressures from an airline and the Air Line Pilots Assn. brought to bear on the Civil Aeronautics Board." Iverson declined to identify any of the airlines involved.

Iverson said that after the union had testified before the House aviation subcommittee, that location of the boost system control on one type of turbine aircraft was hazardous and might have caused the aircraft to crash, the testimony was criticized by ALPA, the Air Transport Assn. and the manufacturer as "being nothing more than fuel" to the union's jurisdiction fight with the pilots.

Recently, the airline involved issued a notice to crews that the flight engineer should stand by on takeoff to disengage the system at the captain's command, Iverson said. The notice urged caution in doing this to avoid a possible fouling of control cables, which, it emphasized, could mean a complete loss of aircraft control, Iverson said.

One Union, Crew of Three Urged for Jets

By Robert H. Cook

Washington—Ultimate responsibility for settlement of the airline industry's pilot versus flight engineer dispute was returned to the bargaining tables last week by a presidential commission which recommended "one union in the cockpit" and a three-man crew for all turbojet operations.

The final report of the commission, which was appointed Feb. 23 to investigate the cause of a strike against seven major carriers by the Flight Engineers International Assn., expands its original findings issued on May 24 (AW May 29, p. 33).

The report was accompanied by a letter from President John F. Kennedy urging all parties to adopt the recommendations and requesting the commission to remain active to receive progress reports and transmit them to the White House. The request prompted Chairman Nathan P. Feinsinger to say that while the commission was "unhappy" over the suggestion it would comply.

While neither side would comment immediately, it was expected that the Air Line Pilots Assn. would support the general findings, and the Flight Engineers International Assn. would object by calling a new series of strikes if the recommendations are adopted. Over-all effect of the report would be the eventual dissolution of FEIA as a union and the unemployment of a high percentage of flight engineers whenever the airlines furlough flight crews.

Airlines May Accept

There is strong industry speculation that airline managements will accept the Feinsinger report, despite the added costs of a recommendation that flight engineers receive extensive pilot training at company expense. Several carriers have fought this suggestion in the past, but may reconsider in terms of gaining a measure of labor peace through dealing with only one cockpit union.

An indication that the report may lead to an early settlement of the cockpit dispute on two major airlines was contained in a commission statement that the "most progress" towards settling the differences between the two unions had been made at Pan American World Airways and Trans World Airlines.

"While serious differences still remain," the report noted, "all parties recognize the need for an early and final settlement."

Neither union has been able to settle contracts with these two airlines because of the crew complement issues and management's desire to await the final Feinsinger report. FEIA has believed that acceptance of the report by either airline might encourage American, Eastern, National and Flying Tiger to take similar action.

Details of the commissions report recommend:

• **Turbojet flight crews** on all airlines should be limited to three men. Flight engineers employed on four-man crews since May 24 would be permitted to continue working without taking pilot training. Any of them possessing a commercial pilot's license and instrument rating would be given a bidding priority towards the third seat position on three-man crews if they complete further pilot training at company expense.

Should he refuse the offer for additional pilot training, presumably the company would be permitted to dismiss the engineer with severance pay.

This provision, along with normal attrition, voluntary separation with severance pay and early retirement, is expected to reduce the ranks of flight engineers in this class, the report stated. Additional pilot training should be offered over a three-year period to no more than one third of the company's engineers during any one-year period, the report added.

• **Flight engineer** severance pay would range from a minimum of $10,000 to a maximum of $25,000. Those on furlough as of Oct. 15 would be considered as severed from employment and would receive severance amounting to one month's pay for each year of service, up to a maximum of six years.

• **Vacancies** which cannot be filled by flight engineers may be filled by pilots either on active or furlough status. Applicants for flight engineer positions must be pilot qualified and should be placed on both pilots and engineers seniority lists. Bidding rights for flight engineer positions would be determined according to their pilot seniority.

• **Pilots displaced** to lower-paying assignments or furloughed as a result of crew reduction would receive pay guarantees equal to their average salary for the six months preceding displacement or furloughing. The pay guarantee period would range from one to four years' duration. Those furloughed would have recall rights.

• **Pilots would be provided** training to obtain flight engineer certificate at company expense, but on their own time. While training they would be scheduled for not more than 60 hours of flight time a month, but would be paid for a full flight schedule.

• **Flight engineers** with commercial and instrument ratings would be provided pilot training under similar provisions. Designed to enable the flight engineer to assist the pilot in the event of an emergency, the training would cover nearly every function performed by copilots, with the exception of landings and takeoffs.

The program would emphasize the ability to execute en route, approach and landing co-pilot duties, with the exception of actual operation of the controls, along with the ability to fly the aircraft in straight and level flight, normal turns, climbs and descents. Training and demonstration of these abilities could be conducted in a turbojet simulator, the report said.

In addition, the course would include the operation of all radio and navigation equipment, plus the handling of air traffic control clearances, en route and approach charts and flight logs.

The report also continued to urge an eventual merger of ALPA and FEIA and recommended that the pilots' union not ask any further representation elections for two years. Chairman Feinsinger explained that this referred to United Air Lines where ALPA won an election to represent all flight deck members. The pilot victory forced the dissolution of FEIA's chapter at United.

No mention was made in the report of the possibility of reducing the total monthly flight time for turbojet crews as an alternative method of settling the crew complement issue. This had been suggested earlier by FEIA.

However, the suggestion has found some favor with ALPA members who last week postponed a strike against TWA which they threatened after the company refused to complete contract negotiations until issuance of the final Feinsinger report.

Members of the TWA joint committee on inter-union cooperation, established to work out a solution with the engineers under recommendations of the original Feinsinger report, complained of the company's refusal in a letter to all TWA pilots.

The letter contended that there has been sufficient agreement between the pilots and flight engineers on acceptance of the earlier Feinsinger findings as a guideline on which to settle the crew complement issue. It emphasized that both parties agreed that "negotiation of a 70-hour flight time limitation for both pilots and engineers with the company would simultaneously supply a needed improvement in working conditions and provide reasonable protection of job equities in reducing from four-man to three-man jet crews."

CAB to Settle Role of Helicopter Services

By Ward Wright

Washington—Case that will decide the future of helicopter service in the Washington-Baltimore area—and possibly set the pattern for development of U.S. helicopter transportation—is scheduled to be heard by the Civil Aeronautics Board late this month.

At stake is what helicopter service, if any, is needed to connect Washington and Baltimore with three major airports in the vicinity of the two cities. Direct helicopter service between Washington and Baltimore is not at issue.

The case raises several points related to the nature of the applicants other than the immediate questions of financial backing, scheduling, and subsidy needs.

Applicants are two local service carriers, Allegheny Airlines and Piedmont Aviation; four local independent helicopter operators, Chesapeake and Potomac Airways, D. C. Helicopter Airways, Pilgrim Helicopter Services and Washington-Baltimore Helicopter Airways; one surface carrier, D. C. Transit System; and one helicopter airline already operating in the New York City area, New York Airways.

Subsidized Experiment

One question is whether CAB should allow the local service carriers to get a toe-hold in the helicopter transport field. As opponents see it, the Board would be making a mistake to grant those carriers, already heavily subsidized, authority to branch into another "experimental" operation needing still more subsidy.

There is precedent for this view. The Board rejected a local service applicant in a 1947 helicopter service case on grounds that the award would place "upon this company the responsibility of conducting two experiments having unusual national significance." The award went to an independent carrier. Since that time CAB has certificated two more independent helicopter airlines.

However, as one local service applicant points out, helicopters have improved greatly since 1947. They are larger, faster and more economical, with still more improvements expected.

This, plus the growth of cities, movement of airports farther from city centers, and the expansion of helicopter routes will lead to inter-city helicopter service operating in direct competition with local service airlines, the applicant contends.

By certificating additional independent helicopter airlines, this carrier says, CAB is laying the groundwork for a problem—conflict with local service operations—which the Board will ultimately have to face. The same carrier regards the "experimental" phase of local service as over for practical purposes, and regards local service airlines as here to stay, subsidy or not. Therefore, it feels the logical evolution of short-haul operations with fixed-wing aircraft may lie with helicopters.

Independents Disagree

The independent helicopter airlines reject this view and regard local service carriers as having enough problems of their own without getting involved in highly-specialized helicopter operations. These operators feel that fixed-wing local service and helicopter operations are two separate fields that can best be developed by each carrier in its own domain.

D. C. Transit System, holder of a congressional franchise to conduct mass surface transportation in the Washington area, sees helicopter service as another step in the development of mass transportation. In its view, the responsibility for developing local helicopter service is consistent with its role as a surface carrier. Responsibility for moving people from place to place locally is its business whether they move by bus or helicopter, the company says.

New York Airways is the only applicant currently conducting scheduled helicopter operations under CAB certification. Some applicants speculate that New York Airways may be seeking authority to operate in the Washington area with an eye toward future linking with its New York system. The firm's reply is that this issue is far beyond the scope of the case and that equipment for such an operation is not available anyway.

80 Applicants Deferred

CAB ordered the investigation last November, eight years after it certificated New York Airways, the last of the three helicopter airlines to receive its certificate. Heavy subsidy involved —over $4 million for Fiscal 1961 and $6 million for 1962—has since caused CAB to defer more than 80 applications to conduct helicopter operations in other cities.

The Board felt that with the completion of a third airport in the Washington-Baltimore area an investigation was necessary to find out whether connecting helicopter service would be needed, in view of the distances between airports and cities. Distance between Washington and Friendship International Airport is about 25 naut. mi. and Washington-Dulles mileage is about 19 naut. mi. Distance between Dulles and Friendship is about 40 naut. mi.

CAB said it was particularly interested in the performance and economics of both existing helicopters and types that could be operated in the near future. It was also interested in the prospect of self-supporting operations in the light of recent advances in helicopter engineering. This data, the Board said, would assist it in determining what action should be taken on pending applications to provide helicopter service in other cities.

The case comes at a time when Congress has been increasingly critical of helicopter subsidies. The report of House appropriations committee in June said that this would be the last year the committee plans to recommend subsidy for helicopter operations. The House, acting on the committee's recommendation, cut the 1962 CAB helicopter subsidy request from $6.9 million to $5 million. The Senate restored the $6.9-million figure, then compromised with the House for $6 million after defeating an amendment that would have eliminated the subsidy altogether.

Equipment Planned

Piedmont, New York Airways and Chesapeake and Potomac Airways each plan to operate three 25-place Boeing Vertol V-107 helicopters, and D. C. Transit System plans to operate two V-107s and four 10-place Sikorsky S-62s. D. C. Transit said it would replace its S-62s with Bell 204B helicopters if the Federal Aviation Agency certifies the 204Bs for airline operations. It estimates the switch would save $200,000 per year in expenses.

Washington-Baltimore Helicopter Airways said it has not decided whether it would operate two 25-place S-61s, or two V-107s with two S-62 helicopters. It also has the Bell 204B under consideration if it should become available for airline use.

D. C. Helicopter and Pilgrim said they would begin operations with four and five S-62 helicopters respectively. Allegheny said it would begin with five piston-powered S-58 12-place helicopters. The carrier said the operating costs of the S-58 are well known compared with newer types and would handle the traffic at a minimum cost to government. As the traffic develops, it would buy larger, newer aircraft, Allegheny said.

Traffic and breakeven need estimates are based on the first year of stable operations—the year when airlines have fully rescheduled operations reflecting

the opening of Dulles. Since the extent the airlines will use Dulles is not yet known, the applicants had to estimate the number of persons needing to travel among the three airports. Figures for persons needing transit from centers to airports, however, were based on various traffic surveys.

Highest estimate of breakeven need for carriers that assumed 1962 as the first stable year of operations was $1.8 million, which Pilgrim submitted based on 850,000 revenue miles with an expected 105,000 passengers at a load factor of 32.3%. The lowest came from Piedmont, which figured its need at $90,000, operating over 350,000 revenue miles with an estimated 169,000 passengers and a load factor of 55%.

Among carriers which assumed 1963 as the first full year of operations, the high breakeven need came from Chesapeak and Potomac Airways, which estimated $1.4 million based on 708,000 revenue miles with 153,000 passengers at an approximate load factor of 16%. The lowest was Washington-Baltimore Helicopter's estimated $556,000 need at 724,000 revenue miles with 229,000 passengers. New York Airways used 1964 as its first full year of operations and estimated that it would make a $90,000 profit that year.

Most applicants feel CAB will rule on the case before the opening of Dulles, scheduled for October, 1962.

Airlines Study FAA Requirements For Lower Jet Landing Minimums

New York—Airlines last week were considering Federal Aviation Agency's newly adopted criteria for operating jet transports under 200 ft., ½-mi. landing minimums instead of the present 300 ft. and ¾-mi. limits.

The carriers have been working for some time to get jet minimums reduced to the level of piston minimums, and FAA recently completed its evaluation of an Air Transport Assn. proposal. The agency advised ATA that a reduction is feasible if "certain operational requirements are met and appropriate restrictions applied."

The criteria call for airport equipment which meets certain specifications, including complete ILS or precision approach radar and full configuration A approach lights in the U. S., maximum glide slope angle of 3 deg., and the greater of 15% or 1,000 ft. of additional runway length over present landing distance required.

Airborne equipment must include a flight director system or approach coupler of demonstrated reliability, and an improved instrument failure warning system or procedure to ensure ready detection of flight instrument failures. Pilot training requirements include an ILS approach to 200 ft. without flight director, an approach to 100 ft. with flight director or coupler, and a landing or simulated landing, plus a one-engine-out missed approach procedure in other than landing configuration. The lower minimums may be used only by captains with 300 hr. in the particular aircraft. During a proficiency check of the above maneuvers, a company check pilot or FAA inspector shall certify a captain capable of using the lower minimums. Also, a "representative number" of a carrier's pilots must be observed by inspectors during periodic proficiency checks, and an at least annual proficiency check will be made of captains.

One of the earliest meetings between an airline and its regional FAA office concerning the criteria is scheduled this week by Pan American, which is anxious to begin operating under the new minimums in time for the bad weather expected later this fall. Pan American has been checking out its pilots under the prescribed conditions, with the exception of the engine-out maneuver at 100 ft., which Pan Am says will not prove anything anyway since the airplane is not supposed to be in landing configuration under the rules. The airline hopes it can work things out with FAA so it will get credit for the training and checkouts already accomplished rather than start over again. Also, Pan Am doesn't feel it is necessary to check its check pilots.

All but five of Pan Am's jets, the airline says, are suitably instrumented and the other five will be fitted by December. Pan Am also believes all its critical airports, i.e., where there are weather problems—will meet the FAA requirements. More than 80% of Pan Am's captains already are qualified in the low-minimum procedures, the airline says.

Pan Am hopes the lower minimums will end a competitive disadvantage whereby foreign flag carriers at airports outside the U. S. can operate under lower minimums than U. S. flag carriers, the latter being subject to FAA regulations. Some foreign flag carriers, Pan Am says, allow captain's discretion in landing minimums.

Weather trends result in a ceiling of 100 ft. or less about 1% of the time, 300 ft. or less about 2½%, and 400 ft. or less about 4-4½%, according to the airline's figures.

Trans World Airlines said last week that it was pleased with the criteria and anxious to go to the new minimums.

Traffic Figures Show More Excess Capacity

Washington—Domestic trunkline traffic continues to reflect the industry's growing concern over excess capacity as last month's figures showed a 12% gain in available seat miles and a bare 0.04% gain in revenue passenger miles.

For the nine months which ended in September, the revenue passenger mile total of 22.14 billion was 0.9% below that of the same period last year, according to Air Transport Assn. figures.

Passenger load factors dropped sharply from 61.6% in September, 1960 to 55% last month. For nine months, the load factor was 57.2 this year, compared with 60.4% in 1960.

Coach service accounted for 61.4% of the total passenger miles last month, as compared with only 50.8% in September, 1960. Over a nine-month period the coach figure has climbed from 48.6% to an average of 57%.

For the one-year period ending in September, the airlines hit a new high of 50.86 billion available seat miles, a 4% increase over the previous year. Total passenger load factors dropped 2.92% during the year.

Available seat miles for first class service was cut 10% to 24.4 billion by the end of last month. On this basis revenue passenger miles of 12.89 billion were 16.5% less than the previous year, and the load factor dropped to 52.83%.

Coach traffic continued to climb, reaching 16.11 billion revenue passenger miles for the year ending in September, for a 16% gain. However, available seat miles increased 21.5% to 26.47 billion and coach load factors began a gradual decrease, reaching 60.86% by the end of September.

ALPA Named Winner Of Safety Citation

Air Line Pilots Assn. was named winner of the 1961 Aviation Week and Space Technology annual Air Safety Award last week for its "distinguished service in achieving safer utilization of aircraft."

Award was presented at the ALPA annual air safety forum banquet by Jerome Lederer, managing director of the Flight Safety Foundation which administers the award. It was accepted on behalf of the Air Line Pilots by C. N. Sayen, president of the organization.

Awards were also presented to Capt. W. L. Collier of Pan American Airways and Capt. B. V. Hewes of Delta Air Lines for "outstanding contribution to the advancement of fire fighting and rescue equipment at airports used for scheduled air carrier operations and other activities for increasing air safety."

TEMPORARY facilities used by National Airlines at Los Angeles include a terminal shared by Air France and TAI. In addition to the Douglas DC-8, a National Lockheed 1049H Constellation air freight plane is pictured above.

New National Routes Offset Florida Loss

By Glenn Garrison

Miami—National Airlines' new routes to California are offsetting losses in the carrier's East Coast market, where tough multi-airline competition is a factor in an uncertain future.

National is optimistic over the prospects of its new southern transcontinental routes, which, like those of Delta Air Lines (AW Oct. 16, p. 36), will tie into the traffic bonanza expected from the location of aerospace projects within the route systems of the airlines.

National officials, like those of Delta, refer particularly to two big new space projects—the Saturn booster production site at Michoud, La., near New Orleans, and the NASA manned space flight laboratory at Houston. These facilities, which will employ thousands of technicians and scientists, fall squarely into National's route area. Houston, formerly National's westernmost point, now is a major link on the airline's West Coast routes.

The space activities at Cape Canaveral, of course, have been and will continue to be a big source of airline traffic, and National now is in a position to exploit this market to the hilt.

National's new routes to the West Coast have shown an average load factor of 53.39% since inauguration June 11. They boosted National's route mileage by 80%, are changing the whole character of the airline to one of national scope and are putting it solidly in the commercial market for the first time.

West Coast Routes

The West Coast routes are credited with National's showing a small net profit for July and August, the first profitable July since 1957. And National officials expect the route expansion will produce a net profit for the next fiscal year, as opposed to a net loss of $7,254,145 for the year ended June 30. Last year's loss was attributed to excessive competition in the New York-Florida market, the recession, loss of the Cuban market, strikes, weather, and losses due to the Lockheed Electra speed restrictions.

But had National had the California routes with a reasonable load factor during its last fiscal year, according to one official, Florida market losses would have been offset and the airline would have broken even financially.

National now operates three Douglas DC-8 and two Lockheed Electra round trips daily between Florida and the West Coast and will expand services as new jet equipment is delivered.

But National, enthusiastic as it is about the potential of its new route pattern, by no means considers the extension a panacea for all its problems. Basic problem is the situation in the New York-Florida market. To National, this problem is principally one of competition, and this is principally a matter of Northeast Airlines operating over the route.

National President G. T. Baker told AVIATION WEEK that the West Coast market, if it works out well, will offset losses on the East Coast.

"But," Baker added, "I'm not in this business to break even."

Over-Competition

Over-competition, Baker said, is National's most serious problem. Northeast is not the whole story. For example, Pan American operates a New York-Nassau-Miami service; British Overseas Airways Corp. flies New York-Nassau and connects to Nassau-Miami services. United brings traffic down over Capital's former routes. National will feel the effects of competing against United instead of Capital, Baker said, although this hasn't made a difference yet.

If Northeast were out of the Florida market, though, it would "help greatly," Baker said. He predicted that National and Eastern might have to file for subsidy if Northeast continues to operate in the market.

There is plenty of competition on the West Coast routes, too, Baker said, including services by Continental and American. Another source of diversion is the new American-Eastern interchange, scheduled to begin Nov. 1, which will provide a daily one-stop, through-plane jet service between San Francisco and Miami via Chicago. This service, Baker said, will bleed off some of National's transcontinental traffic but probably won't be a major headache for National.

National, however, has filed a vigorous protest with the CAB against the interchange proposal.

National soon will receive the first turbofan DC-8 in a fleet expansion to handle the new routes. Baker said National will schedule as much as the market can stand, and no more. His philosophy is to operate so as to get the best loads and not schedule frequency for the sake of frequency.

Most airlines, Baker said, have been buying airplanes "like bananas" but National has taken a more conservative approach.

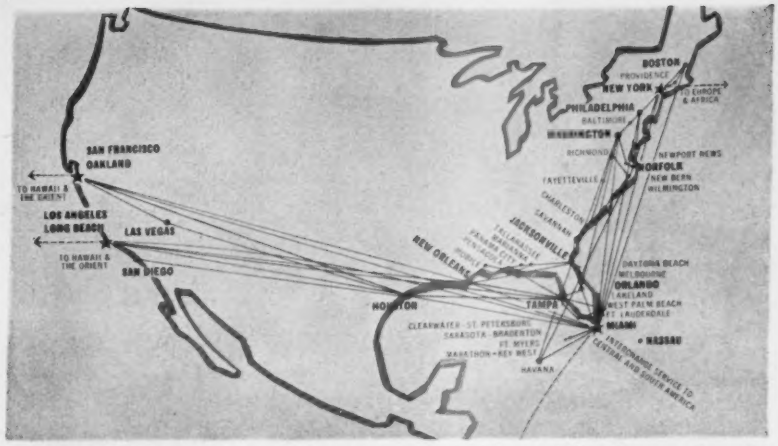
While National has suffered from the expenses of Electra speed restrictions, the Electra is now a good airplane and will operate satisfactorily in smaller points where there is no need for the high capacity of a jet, Baker said. National eventually will be needing a small jet but hasn't made any decisions yet in that area.

If National keeps its present three DC-8s—having the option of trading them in on the last three turbofans—the present jets will not be retrofitted to fan engines, Baker said. This would be too expensive and of insufficient value to National's operation.

National's six turbofan DC-8s, with a price tag of $31,800,000, are scheduled for delivery next March, April, May, September, October and November. This month, however, the airline expects to receive a demonstrator aircraft from Douglas so earlier turbofan operation can begin.

Under the agreement, the demonstrator will be traded back to Douglas against delivery of any one of the first three new turbofans. Trade-in value depends on the length of time National uses the demonstrator, but is estimated at $385,000 less than the cost of the aircraft. This, in effect, boosts the total price of National's new airplanes from $31,800,000 to $32,185,000.

Douglas also will accept trade-in of National's present three DC-8s at an aggregate value of about $12,669,000. If they are traded in, they will be leased back to National for eight years at rates that would reimburse Douglas for the trade-in value plus an amount which is equivalent to an interest factor of 6%.



ROUTE EXTENSION to four California cities boosted National Airlines' route mileage by about 80%. The airline began services over new routes June 11, now is operating five daily round trips between the East and West with DC-8 and Lockheed Electra equipment.

Douglas also has agreed to accept National's note for $5 million prior to delivery of the third new aircraft. This loan is to be repaid monthly, but is to be reduced by any proceeds National may receive from sale of its 400,000 shares of PanAm stock, after payment of a $4,500,000 bank loan secured by the stock.

National's financing situation regarding the new equipment "now looks pretty good," according to W. F. Johnston, vice president and treasurer. With about $10 million from a sale of subordinated debentures, the trade-in arrangements, and cash flow from depreciation, the airline would have been about $5 million short in meeting the total cost of the equipment transaction, including spare engines and other parts at an additional value of $2,528,000. The Douglas loan will make up this difference.

National's cash position is aided by cash generated from depreciation, about $1 million a month at the financial breakeven point. The airline can show a profit of $4-5 million without tax liability, Johnston said, because tax credits resulting from previous losses can be carried forward five years.

The carrier has paid back about $4 million in bank loans since March, now has $41 million outstanding in bank loans. Current assets at Aug. 31 totaled $29½ million against current liabilities of 24½ million. Debt equity ratio is about 1.2 to 1.

Johnston said the picture looked "dismal" last year and would not have brightened a great deal without the southern transcontinental award. One effect of operation on the new routes has been to reduce over-all unit costs by about 20%. In August, 1960, the cost per available seat mile on National's routes was 3.79 cents; last month, the figure was 3.21 cents. It will descend lower, Johnston said, and during National's winter traffic season should drop to 3.10 cents.

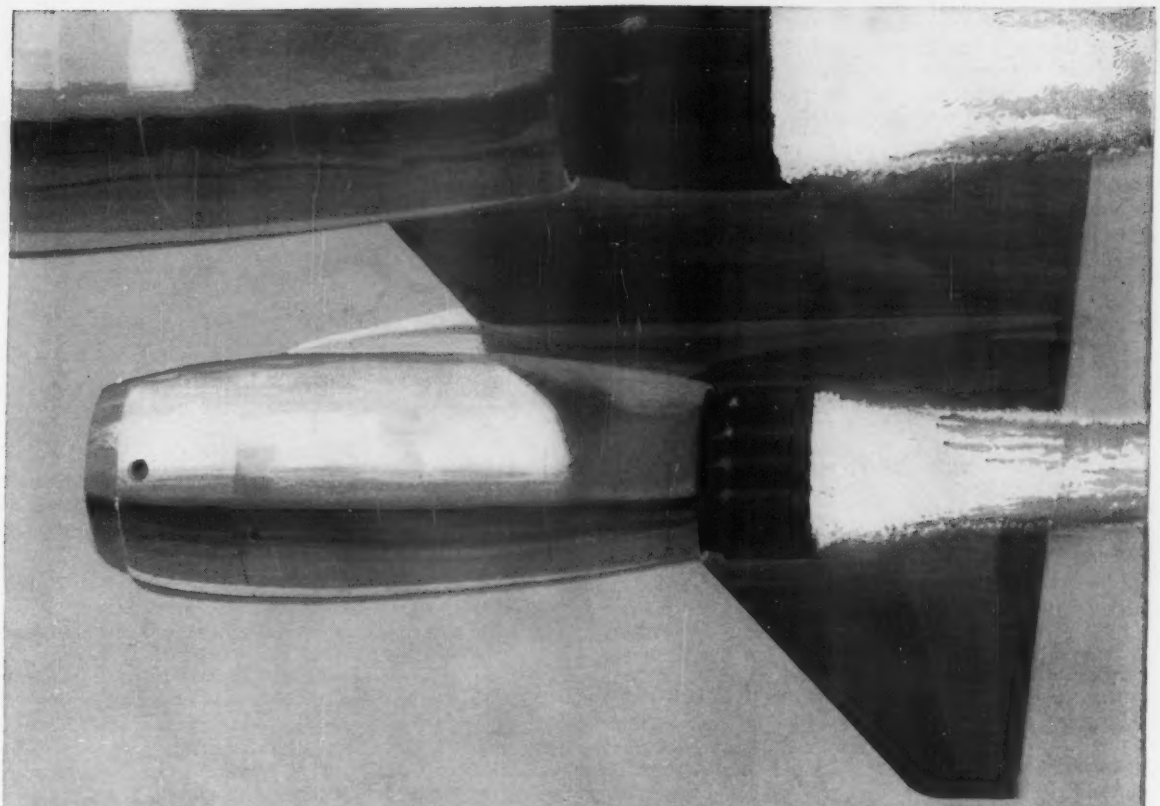
Both Johnston and J. C. Brawner, executive vice president, predict a net profit for the current fiscal year because of the route expansion. Figures for September, Brawner says, will show a loss and October's results will be a smaller loss; by November, a small profit should be made and then National is into its Florida traffic season when normally it should do well.

If Northeast is off the route next winter, "all bets are off," Brawner said. But even if Northeast is still competing, there is a question as to how effective it can be in its present financial straits, he added.

Brawner estimated the breakeven load factor for the West Coast routes per se without allocating any costs of the rest of the system, at 42%. System breakeven load factor is about 52%, and jet breakeven load factor on the system, not allocating the cost of stations other than those served by jets, is about 45%.

National's basic problem, Brawner says, is its New York-Miami route. The Florida market is not what it was several years ago, and there has been an erosion of the traffic available to National on this route.

Among the factors affecting the pleasure travel in this market have been the loss of Havana as a service point. National, before suspension of service to Cuba, operated two New York-Miami-Havana round trips and six local round trips between Miami and Havana. More vacationers now are going to the Caribbean islands rather than to



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Miami. The Miami market was affected by the bad weather there in the winter of 1957-58, which probably frightened off many potential Miami travelers and drove them farther south to Jamaica. That island has been doing a big tourist business, as has Puerto Rico. However, the leveling off of Florida's tourist trade is temporary, Brawner believes, and the area will never lose its attraction as a tourist center.

On the other side of the coin, Florida is becoming a business travel center, with missile, electronics and other industrial developments growing fast.

Although the Caribbean area is diverting some Miami business from National's East Coast markets, the area is a target for Miami gateway traffic by National and this is a strong element of the airline's West Coast promotional effort.

Whereas, Florida as a travel attraction in itself might not appeal to the West Coast vacationer particularly – being more or less what he is used to in California–the Caribbean area does appeal to the Californian, according to Jack Westfall, assistant to the vice president, traffic and sales. This is a big tourist potential for the southern transcontinental routes, and National is stressing the "Floribbean" theme in its West Coast advertising.

Triangular Routing

One plan is to sell West Coast business on a triangular routing from California to New York and then back via Miami, or vice versa, to combine business and pleasure in a single trip. An ad promoting this scheme will feature a traveler with brief case in one hand and fishing rod in the other.

Miami also will be promoted as a gateway to Europe.

In the other direction, the market in Florida for selling tourist travel to California is limited, but Hawaii and the Orient offer a promising potential. To this end, National's western interline salesman, who formerly covered territory between Houston and California, now covers a territory that begins at California and extends westward.

Westfall reports a "tremendous explosion of spirit" within National's sales organization as a result of the route expansion. It wasn't getting the California routes so much as the fact that National was selected to become a major carrier, Westfall said. Whereas National had been "pushed around and outgunned" by the bigger carriers who had three salesmen to National's one, National now is in a position to go out and compete effectively.

National is concentrating a great deal on the national defense aspect of its new market in sales calls and other selling efforts. The West Coast market is primarily commercial, and marks the first time National has been in a big commercial market.

Building identity in the new market is a major problem, according to Baker. Among the techniques which will be used to build a new image as a national carrier is a national advertising program.

The new routes also provide potential for commercial cargo business. National is flying an all-cargo Lockheed 1049H between Orlando-Los Angeles via Houston and Tampa. Baker is particularly unhappy about a restriction on National's cargo operation between San Francisco and Los Angeles.

A byproduct of the new routes is the addition of new convention cities to increase National's share of this kind of traffic. New York, Miami and Washington were the airline's big convention centers before; now Las Vegas, Los Angeles and San Francisco have been added. The new cities are expected to double National's convention revenues. Also, the expansion will boost National's charter business, which last year amounted to $1½ million in the commercial area.

The physical and operational aspects of extending the route pattern were not a major problem for National, its officials say. Johnston put the approximate cost of setting up at the four new cities of Los Angeles, San Diego, San Francisco and Las Vegas at about $200,000, to be written off in a three-year period. National's total personnel numbered 3,410 at the end of May, now numbers 4,050.

Electra Engine Removals

Miami–National Airlines is displeased with the Allison engines powering its turboprop Lockheed Electras, according to J. M. Wolgast, the airline's chief of maintenance and engineering.

Premature removal rate on the engines increased after the aircraft was returned to speed, Wolgast said. The rate now is one removal for every 1,000 hr. of engine time. This includes removals for all causes, not necessarily failure of components.

Failures have occured, however, particularly in turbine, compressor and reduction sections, according to Wolgast. By way of comparison, he said, National's R 2800 engines in its DC-6 series aircraft have a premature removal rate of about .25 to .3 per 1,000 hr. Cost of the Allison overhaul, Wolgast said, is about $18,000–same as that of the JT4 in National's DC-8s.

The Electra costs per flight hour on a 12-month average basis, Wolgast said, run $175-$180 in flight operation. This would be about the same as the DC-6B costs–$165–except insurance costs on the Electra are higher.

About $750,000 will be spent in checking out crews required between now and next June for the first three new aircraft, according to L. W. Dymond, vice president, operations. A similar amount will be required for the three airplanes to be delivered next fall. Pilot requirements may mean hiring additional pilots next fall, but in the interim National expects only to recall pilots from furlough. About 30 pilots will be recalled. Over-all average cost for checking out a crew is about $53,000.

Transition from the present straight jets to turbofans will not present a problem because National's jets have the JT4 engine, and the JT3 turbofans will provide about the same performance including takeoff thrust. Big difference, Dymond said, is in fuel economy.

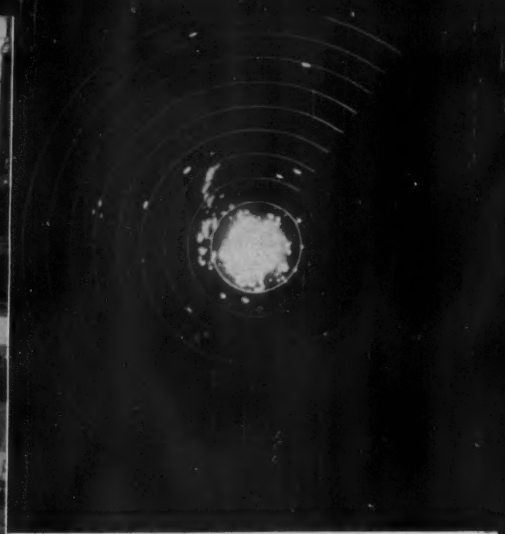
National's ground communications for the new routes west of Houston are tied in to Arinc's Los Angeles operation and should work out better than the setup between Miami and New York. Dispatch in Miami can talk directly to any flight, via telephone line to Los Angeles and radio to the plane. National has two flight control offices, one in Miami and one in New York (because of the weather and traffic density problems in New York), and it will not be necessary to setup another flight control office on the West Coast.

National has both Electra and DC-8 simulators at Miami. The base here handles all airframe overhaul and piston engine overhaul. Jet engines are trucked to Dallas for overhaul by Southwest Airmotive, while the Allison engines in National's Electras are overhauled by the manufacturer.

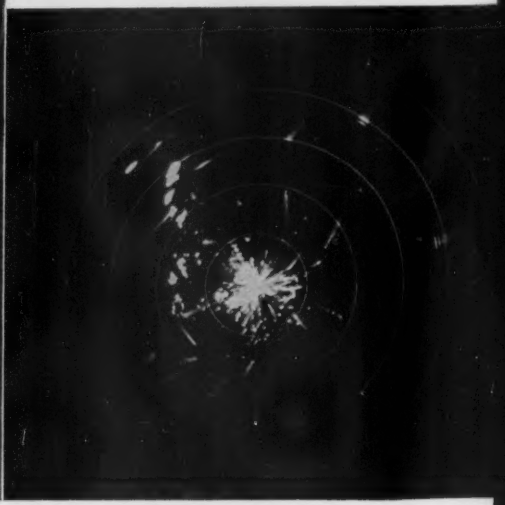
National is expanding its overhaul activities, and this month, began doing QEC work on the Allisons.

Dymond says National has been very satisfied with the JT4 engines, experiencing only one shutdown in flight since the start of operation in the spring of 1960. TBO (time between overhaul) has just been approved at 1,600 hr., about 200 hr. higher than the approved TBO on National's DC-7 engines. Experience with the DC-8 generally has been good, Dymond said. Regarding the hydraulic troubles which have been in the news lately, Dymond said National has experienced no emergency it hasn't been able to cope with. National, he said, pioneered the procedure under which the auxiliary hydraulic system can be used for positive control of brakes and nose wheel steering, except in the case of absolute and complete hydraulic failure. National pilots have never had to use air for braking or dispense with nosewheel steering.

Average utilization of National's DC-8s for the 12 months ending June 30



Unretouched photos show conventional radar scope with single target display (above) and Raytheon bright display with continuous target tracking (below).



FAA orders new Raytheon bright display to further improve air traffic control

Raytheon's Radar Bright Display System, soon to be operational after three years of development, will mean safer transport for the flying public and greater traffic-handling capacity with existing control facilities. Features include —

SCAN CONVERTED DISPLAY

- ☐ Clearly visible under normal room lighting
- ☐ Target movements self-plotted in true position on map coordinates
- ☐ Adjustable memory, able to retain target signals for minutes
- ☐ Multiple location monitoring displays readily available
- ☐ TV-transmissible picture
- ☐ Instant image erase and rewrite within 2 seconds

POSITIVE AIRCRAFT IDENTIFICATION

- ☐ Sharp, bright flight tracks, displayed in real time
- ☐ Adaptable for identification symbols that lock-on and move with target
- ☐ Unmistakable hand-off assignments

RELIABLE PERFORMANCE

- ☐ Transistorized circuitry
- ☐ Light, compact, sturdy construction
- ☐ Low heat generation
- ☐ Simplified servicing

The Federal Aviation Agency has ordered 51 RBDE-5 equipments for control centers from Hawaii to the East Coast. Their advantages are available for radar, sonar, computer output and other display applications, to meet either Military specifications or the most exacting commercial requirements. For full technical details on Raytheon Scan Conversion Bright Display Systems, write: *Raytheon Company, Dept. 72, Lexington 73, Massachusetts, Attention: M. B. Curran*

RAYTHEON COMPANY

EQUIPMENT DIVISION

RAYTHEON

Eastern Predicts 1961 Loss

New York—Eastern Air Lines is certain to show a loss for 1961, President Malcolm MacIntyre said here recently, but should get back in the black next year with a net profit after taxes of $10-12 million.

Principal reason for MacIntyre's optimism concerning 1962 is the fact that Eastern, which has been at a competitive disadvantage with a scarcity of jet equipment, will have tripled its jet fleet between July, 1961 and January, 1962. This will greatly improve the carrier's relative position in the industry, MacIntyre said.

He is not counting on the "demise" of Northeast Airlines in making this prediction, MacIntyre said—but "we're hoping" that Northeast will be out of the Florida picture.

MacIntyre said he doesn't feel over-competition is as significant an element in the airline industry's present troubles as some other carriers do. Where over-competition exists, it is not entirely the fault of CAB: while CAB "has created too many people flying in too many places," the members of industry itself have contributed to this by requesting competitive routes.

The Eastern official said he hoped CAB would allow the airlines to discuss fares without being liable to anti-trust prosecution. No discussion of services offered, which was allowed, is meaningful if unrelated to fares, MacIntyre indicated. He favors new fare levels which may be selective but which will average over-all about 5% higher in terms of revenue per revenue passenger-mile than at present.

Eastern plans to extend its air bus and air shuttle services, probably next spring, MacIntyre said. The shuttle is definitely making a profit, MacIntyre said, and soon will be at a level where profit could be made even if equipment were not fully depreciated.

The recent meeting between CAB and airline presidents among other things acted as a "catalyst," MacIntyre said, in advancing plans for spare parts pooling among domestic carriers. The industry had been dragging its feet domestically in this matter, the Eastern president said, but is now working out suitable arrangements.

In his discussion of industry problems, which took place at a press briefing here, MacIntyre said local service carriers are troubled over a basic problem concerning their future function: Are they feeder services to trunk points or are they transportation agencies between the points they serve? A number of local service carrier presidents recently met with Eastern to discuss such matters and "they are torn on this question," he said.

Eastern has been making a study of its two-engine services to determine what proportion should be kept operating and whether Eastern should key such service to connecting flights or allow local service carriers to handle this feeder function.

was 7 hr. The average now is running about 11 hr.

National's maintenance goal is a maximum of five days each year out of service for its DC-8s and Electras by 1963, according to J. M. Wolgast, chief of maintenance and engineering. The DC-8 is now running about seven days, the Electra 14.

DC-8 Maintenance

The DC-8, Wolgast says, was the first plane to enter service with a complete maintenance program set up by an Air Transport Assn. committee and approved by FAA.

This meant more similarity of programs among the airlines than ever before. Basic concept is seven blocks of 2,500-hr. increments.

Since the routine work is only 40% of the total man hours, with service bulletins and other special work making up the rest, airlines vary their format as to how much of the extra work is done in a block.

National's approach, in trying to hold the block working days to five, is now to take all components out of the blocks and break them down into work to do each night. When the service bulletin programing is completed, however—some time next year—National expects to return the components to the block and still maintain the five days. It is desirable to have the components back in the block because, with the small breakdowns, aircraft are not available often enough, Wolgast said.

From a maintenance standpoint, the DC-8's problems included complex electrical system troubles which Wolgast said were difficult to understand and fix. Hydraulic troubles were not a major problem from the maintenance side. As of today, difficulties in the various DC-8 systems, Wolgast said, are rated as average for a transport aircraft.

In addition to the three DC-8s and 14 Electras, National's present fleet consists of four DC-7s, five DC-7Bs, four DC-6s, eight DC-6Bs, six Convair 440s, and four Lockheed 1049H Super Constellations, of which two are in all-cargo configuration.

New Rule Is Planned For Gyroplane Ratings

Washington — Federal Aviation Agency will require pilots interested in earning new "gyroplane" ratings to demonstrate a series of flight maneuvers —some common to helicopters, others to fixed-wing aircraft—if they do not already hold the Agency's old "autogyro" rating.

Recent certification of the Umbaugh U-18 gyroplane apparently led FAA to propose a rule that would subdivide its rotorcraft pilot rating into helicopter and gyroplane classes (AW Oct. 9, p. 35.) When this rule is adopted, FAA plans to allow pilots who earned one of the old autogyro ratings issued by the Agency in the 1930s to apply for a "Rotorcraft-Gyroplane" license. No flight test would be required because, FAA says, the two aircraft types are very similar.

But pilots holding fixed-wing or helicopter licenses would have to demonstrate proficiency in these maneuvers in order to earn a gyroplane rating: high rate of descent letdowns, jump takeoffs followed by transition to forward flight, full flare landings, spiral descents, turns around fixed points on the ground and minimum-speed flight at about 27 mph.

Private and commercial gyroplane licenses will require 40 and 200 flight hours respectively, as do present fixed-wing licenses. However, FAA does not intend to specify a minimum number of instruction hours before an applicant can take the gyroplane flight test. A recommendation from any FAA-approved instructor will suffice.

On the theory that the gyroplane's in-flight characteristics resemble those of a fixed-wing aircraft more closely than those of a helicopter, FAA plans to require helicopter-rated pilots to pass the gyroplane flight test before qualifying in the new aircraft.

Autogyro or gyroplane pilots also must pass a flight check in order to qualify on helicopters.

Three Are Promoted To New Posts at FAA

Washington — Federal Aviation Agency has named Robert H. Willey as assistant administrator for personnel and training; John R. Provan as director, office of management services; and Clarke H. Harper as director of the office of budget.

Willey replaces Fordyce W. Luikart, who will become deputy director for administration in the Agency's International Aviation Service. Provan replaces Harper, who had served the post on an interim basis since July.

PIPELINE IN THE SKY

Riddle Airlines Inc. are flying Argosies up to 13 hours daily on the U.S.A.F. Logair routes. Logair is one of the world's largest scheduled cargo operations — an aerial pipeline for the quick supply of urgent military equipment. From coast to coast these new Armstrong Whitworth aircraft speed outsize military loads in their capacious 47 ft. long holds, over a network of routes covering the U.S.A. Daily schedules bridge more than 12,000 miles.

Soon, B.E.A. will be doing the same on their all-freight routes. Argosies will open up new high-speed supply lines for outsize cargoes between the U.K. and Europe.

An Argosy fleet means high speed delivery, reduced warehousing, less packaging, less handling time, less shipping cost and — above all — unusually large freight dimensions.

HAWKER SIDDELEY AVIATION

32, Duke Street, St. James's, London, S.W.1.

Three Airlines Protest American-Eastern Pact

Washington—Three trunklines have protested an American Airlines-Eastern Air Lines aircraft lease agreement that would permit single-plane jet service between San Francisco and Miami via Chicago after Nov. 1.

The agreement would allow an American jet to fly its San Francisco-Chicago route, then continue on Eastern's route to Miami during winter months. During summer months, an Eastern jet would offer the same service.

Delta Air Lines and National Airlines, both protesting the lease, received West Coast-Southeast route awards in the Southern Transcontinental Service Case (AW Mar. 20, p. 36). Both airlines contend the lease is an aircraft "interchange" designed to thwart the Civil Aeronautics Board's aims in the Southern Transcontinental Case. United Air Lines is also protesting the agreement.

Trans World Airlines has asked the Board to lift its restriction requiring a change-of-plane at St. Louis on its West Coast-Southeastern routes if it considers the American-Eastern aircraft lease.

British Board Plans Stringent Licensing

London—British Air Transport Licensing Board last week served notice on United Kingdom airlines that it would take a harder look at airline finances before granting route certificates.

The board told Minister of Aviation Peter Thorneycroft that it is in the process of examining the financial standing of all operators but this will take some time. "Meanwhile, the grant of licenses for services to be operated in the near future must, in most cases, rest upon a more perfunctory examination of financial resources than we shall make later on," the board said.

In addition, the board expressed its concern with airline insurance, noting ". . . we feel we should record that the licensing system we are under duty to administer cannot, of itself, guarantee that passengers in British aircraft or innocent victims on the surface will be compensated to the full legal liability of the operator in all circumstances.

"Facing the board is the fact that insurers will not accept a liability which is unlimited and will not in all circumstances accept even a limited liability. . . . We can do no more than try to ensure that operators' standard of coverage both as regards amount and terms and conditions, is not out of line with the best practice in the industry."

C-141 Subcontracting

Washington—Air Force last week approved three major subcontractors to build the tail assembly and the main and nose landing gears of the C-141 turbofan cargo transport being developed by the Lockheed-Georgia Co. at Marietta, Ga. (AW Oct. 9, p. 50).

Convair Division of General Dynamics Corp., San Diego, will build the tail assembly under a $6.5-million contract.

Bendix Products Division at South Bend, Ind. will build the main landing gear under a $600,000 contract, and the nose landing gear will be made by Cleveland Pneumatic Industries, Inc. under a contract for $465,000.

All three contracts cover detailed engineering, tooling, planning, production, spares and testing of components for the first five aircraft. Follow-on contracts will be let to successful bidders for additional production lasting several years.

There were 12 bidders for tail assembly work, three for the main landing gear and five for the nose landing gear.

Government Is Blamed For Airline Problems

Washington—Unwillingness or inability of the federal government to assume responsibility for national transportation policies has been blamed for U.S. airline problems by Brookings Institution transportation expert Wilfred Owen.

In a booklet prepared for a symposium on air transportation to be held in Hartford, Conn. Nov. 1-3, Owen said the need for air carrier mergers according to a federal plan is "becoming more apparent as the jet age continues to alter circumstances and solutions."

Owen cited these as other problems: A divergence of attitude between Civil Aeronautics Board and the State Department over bilateral agreements; the fact that 90 out of 100 Americans have never flown; and the fact that the federal government pays $10 in subsidy for every local service passenger.

Newark Jet Traffic Further Expanded

New York—Jet service at Newark Airport will be further expanded Oct. 29 as American Airlines, which had previously balked at restrictions (AW Oct. 16, p. 43), schedules a daily service to Chicago and on to Los Angeles. Eastern also plans jet service at the airport beginning in January.

American is understood to have made a last-minute decision to fall in line with the competition and put jets into Newark. It will use Boeing 707-120B and 720B equipment.

Eastern plans to operate two daily DC-8 nonstops, one to West Palm Beach and one to Miami.

Scheduling of jets at Newark was deeply immersed in politics in view of local controversy over jet noise. Flights are restricted to daylight hours and are expected to meet the Port of New York Authority's takeoff noise criteria. United already operates Sud Caravelles from Newark, and TWA has announced plans to operate 707-120s beginning Oct. 29.

Halaby Cites Danger In Loss of Airports

Chicago— Federal Aviation Agency Administrator N. E. Halaby last week warned that as urban residents flood U. S. suburbs, the economics of real estate are shutting down more and more general aviation airports and creating a problem of "ominous proportions."

Halaby told the Ninth Annual Air Safety Forum of the Air Line Pilots Assn. that many general aviation airports are endangered by those who would "make an immediate and certain profit rather than make a long-term, and possibly controversial, investment in the future."

Every time a general aviation airport is turned into a shopping center and parking lot, Halaby said, the traffic patterns of major terminals move closer to the saturation point. Prime example of this trend is Mitchel Field in Long Island, N. Y., a deactivated Air Force base that FAA would turn over to business and commercial aviation groups, he said. But neighboring residents, supported by a strong congressional delegation, have successfully opposed this move thus far.

In another warning, Halaby said that U. S. airlines would be held responsible for "letting drunks" board their transports. Loading and ramp personnel, the administrator maintained, should bar anyone under the influence of alcohol "or otherwise affected."

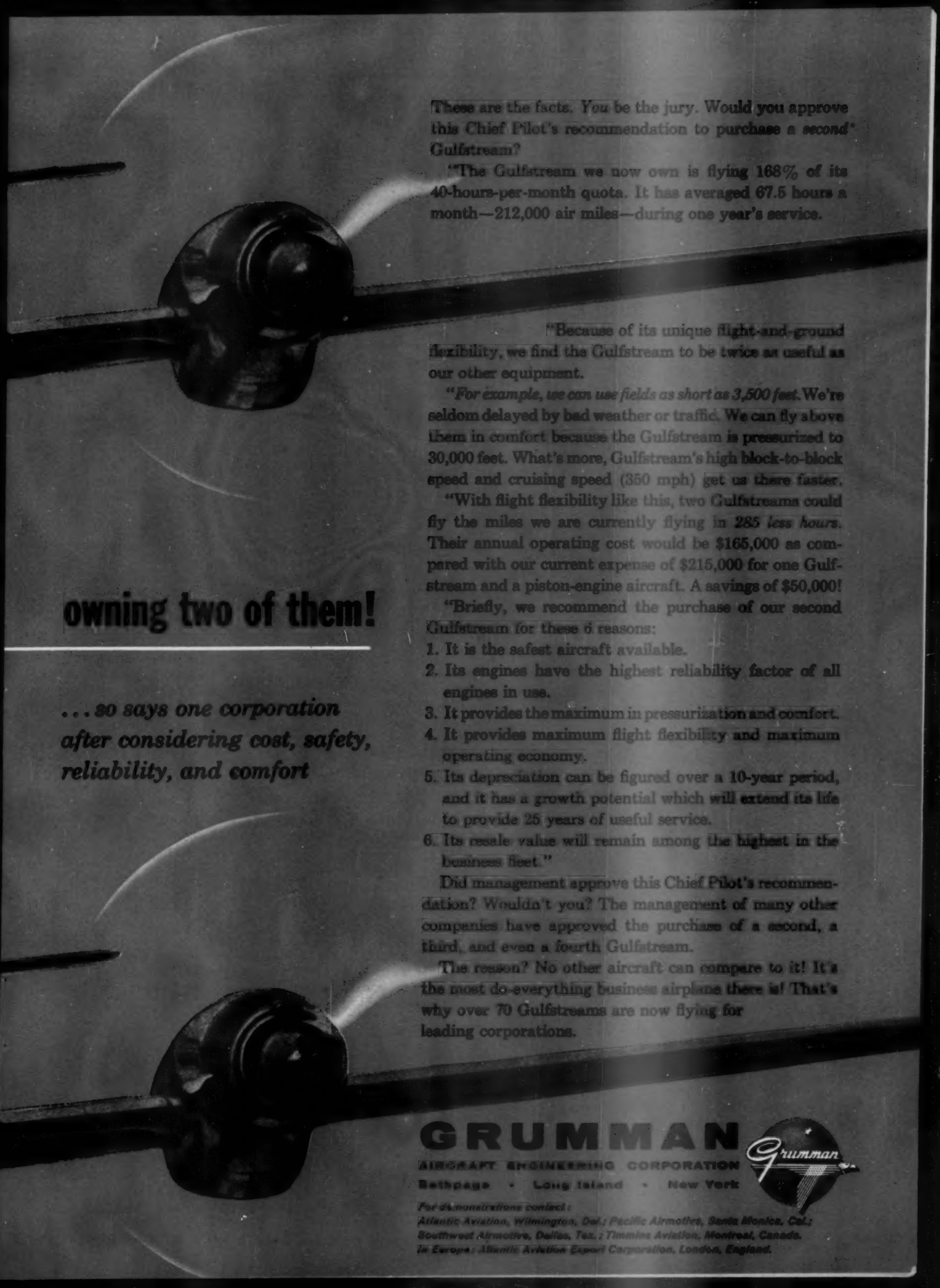
Braniff Orders BAC Jets

Washington—Braniff Airways has ordered six British Aircraft Corp. 111 jet transports to be delivered beginning October, 1964, and has an option to buy six more scheduled for delivery beginning the summer of 1965.

Braniff said it adopted the BAC 111 after "more than a year" of comparing it with other short-range jet aircraft. Cost of the 12 aircraft, including spare parts, will be $35 million.

Among other aircraft considered were the Sud Caravelle, the Boeing 727, and other types proposed by Boeing and other U.S. manufacturers.

Only one thing better than owning a Gulfstream:



owning two of them!

. . . so says one corporation after considering cost, safety, reliability, and comfort

These are the facts. *You* be the jury. Would you approve this Chief Pilot's recommendation to purchase a *second* Gulfstream?

"The Gulfstream we now own is flying 168% of its 40-hours-per-month quota. It has averaged 67.5 hours a month—212,000 air miles—during one year's service.

"Because of its unique flight-and-ground flexibility, we find the Gulfstream to be twice as useful as our other equipment.

"*For example, we can use fields as short as 3,500 feet.* We're seldom delayed by bad weather or traffic. We can fly above them in comfort because the Gulfstream is pressurized to 30,000 feet. What's more, Gulfstream's high block-to-block speed and cruising speed (350 mph) get us there faster.

"With flight flexibility like this, two Gulfstreams could fly the miles we are currently flying in *285 less hours*. Their annual operating cost would be $165,000 as compared with our current expense of $215,000 for one Gulfstream and a piston-engine aircraft. A savings of $50,000!

"Briefly, we recommend the purchase of our second Gulfstream for these 6 reasons:

1. It is the safest aircraft available.
2. Its engines have the highest reliability factor of all engines in use.
3. It provides the maximum in pressurization and comfort.
4. It provides maximum flight flexibility and maximum operating economy.
5. Its depreciation can be figured over a 10-year period, and it has a growth potential which will extend its life to provide 25 years of useful service.
6. Its resale value will remain among the highest in the business fleet."

Did management approve this Chief Pilot's recommendation? Wouldn't you? The management of many other companies have approved the purchase of a second, a third, and even a fourth Gulfstream.

The reason? No other aircraft can compare to it! It's the most do-everything business airplane there is! That's why over 70 Gulfstreams are now flying for leading corporations.

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For demonstrations contact:
Atlantic Aviation, Wilmington, Del.; Pacific Airmotive, Santa Monica, Cal.; Southwest Airmotive, Dallas, Tex.; Timmins Aviation, Montreal, Canada.
In Europe: Atlantic Aviation Export Corporation, London, England.

AIRLINE OBSERVER

► International carriers are concerned over the lack of airspace on North Atlantic routes. With as many as 65 turbojet flights operating over 29,000-ft. altitudes, traffic is being squeezed into a narrow corridor, creating critical air traffic control problems. Available airspace has already reached the saturation point during certain peak periods.

► **Airline optimism over the realism of a 1970 target date for delivery of a supersonic transport is fading. Most carriers feel that the date would be practical only if research and development funds were immediately available, backed by a fully coordinated industry-government program. Most industry technicians now feel that the supersonic transport will appear in the western world well beyond 1970.**

► Civil Aeronautics Board plans to strengthen its reporting regulations governing supplemental airline operations. A proposed change would require the carriers to retain statistical reports and ticket records at their principal offices for a period of three years. The Board noted that it has had difficulty inspecting these records because several of the carriers kept them in ticket offices throughout the United States.

► **Alitalia, the national airline of Italy, recorded a 58% gain in North Atlantic traffic during the first nine months of this year, over the same period last year. For September the airline had a 56% load factor, with a traffic increase of 33% over September of 1960.**

► Convair engineers have designed modifications for the CV-990 aimed at meeting a maximum speed guaranteed to purchasers of at least one knot faster than the Boeing 720B. Flight tests show the aircraft actually is 19 kt. slower. Fix will include a new wing leading edge, which tests show may add 14 kt. to the top speed, and the addition of fairings on either side of the engine nacelles. Fairing modification will require a redesign of thrust reversers which will move aft before closing.

► **Sen. A. S. Mike Monroney (D.-Okla.) chairman of the Senate Aviation Subcommittee, has warned air cargo executives that the airfreight industry must move ahead quickly with automation of cargo loading operations "before someone like Jimmy Hoffa" moves in. At a recent Oklahoma City meeting, Sen. Monroney cited the problems the shipping industry is having with Hoffa's Teamsters Union as a danger also facing airfreight carriers.**

► Look for Air Line Pilots Assn. to sever all ties with Pilots Employment Agency, a Teterboro, N. J., job placement firm whose aid was enlisted by union President Clarence N. Sayen in an effort to find work for furloughed airline copilots. ALPA officials now feel that the employment agency helped break ALPA strikes by supplying several airlines with non-union pilots.

► **International Air Transport Assn. will conduct a cargo symposium early in 1962, covering both economic and operational aspects of cargo service.**

► Aeroflot has turned to cheesecake in its advertising campaign designed to lure more passengers from railroads. Posters promoting air travel to and from Black Sea resorts have been appearing right beside railroad ticket counters. Soviet press has been more critical of the use of laughing bathing beauties than as to where the posters are placed.

► **Bonanza Air Lines credits promotional fares, such as its "Bonanza Land" tours, for a third quarter gain of 24% in revenue passenger miles over the same period last year. The airline's over-all passenger revenues also increased by more than 20% over the third quarter of last year, indicating the impact of newly-generated traffic.**

► United Air Lines has painted shuffleboard patterns on aisle floors throughout its jet maintenance base at San Francisco. Games are played by employes during lunch hours and coffee breaks.

SHORTLINES

► **Air Transport Assn.** has created an Office of International Services to coordinate its international programs. Office will begin operations on Nov. 1 with Norman Philion as director.

► **American Airlines** has installed a test bench to monitor the overhaul of Convair 990 autopilots at its Tulsa maintenance base. Bench simulates the 990's altitudes, speeds, course, pitch, roll and yaw.

► **Bonanza Air Lines** has an option to buy a tenth F-27 turboprop transport from Fairchild Stratos Corp.

► **Braniff Airways** will begin nonstop cargo service with DC-6A air freighters eastbound between Tulsa and New York City on Oct. 30. Flights will leave Tulsa 12:05 p.m. Monday through Friday. Return flights will be nonstop to Dallas.

► **Central Airlines,** only local service carrier that did not adopt class service rates for determining subsidy payment (AW Mar. 20, p. 37), has asked Civil Aeronautics Board to put it on the class rate as of last Oct. 1.

► **Civil Aeronautics Board** has dismissed complaints against Flying Tiger Line's new cargo tariff (AW Oct. 2, p. 45) by freight forwarders and competing airlines.

► **Continental Air Lines** is flying salesmen's sample cases and other hand-carried business equipment at freight instead of higher excess baggage rates. Salesmen are to advise the ticket counter which cases should go as freight and which should go as baggage.

► **International Air Transport Assn.** will establish a regional office in South America, probably at Rio de Janeiro, before the end of the year.

► **Piedmont Airlines** has adopted the experimental youth fare plan, with the same provisions as those of the trunklines.

► **Trans Caribbean Airways'** attempt to acquire Resort Airlines' certificate has been turned down by CAB. Transfer of the certificate would have allowed Trans Caribbean to expand its Caribbean operations.

► **Trans World Airlines** has CAB permission to suspend its service to Algiers and Tunis after a sharp decrease in traffic this year. TWA blames political unrest for the decline.

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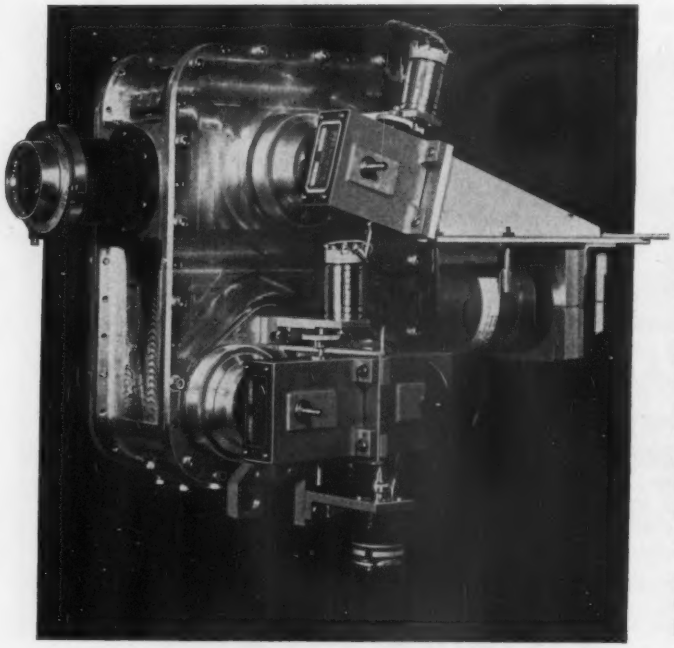
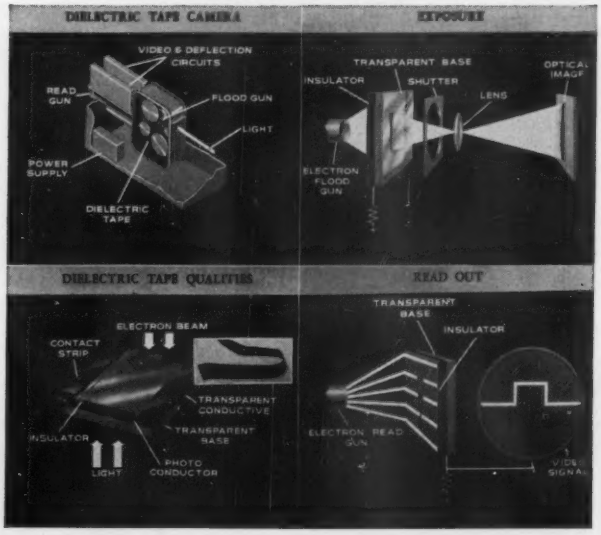
CAN'T
TOP
WESTERN
AIRLINES
MIGHTY
JET-AGE FLEET
NEW 720B FAN/JETS
Fastest jets you can fly along the Pacific Coast and to Mexico City, too.
707 JETS
Fastest between Los Angeles, Salt Lake City, and Minneapolis. Fastest between San Francisco, Denver, Minneapolis.
JET/PROP ELECTRA II'S
Fast and comfortable way to Phoenix, San Diego, Long Beach, Las Vegas, and Oakland from major Western Cities.

PHOTO-DIELECTRIC TAPE CAMERA SYSTEM

. . . a major advance in space image-sensing





The development of photo-dielectric tape permits the design of a totally new image-sensing system for utilization in satellites and space vehicles. A prototype camera for use with this tape has already been operated and tested. This system, one of the first developed primarily for use in space, offers a number of advantages over existing photographic and television techniques.

Operating on the principle of storing an optical image by converting it to an electronic charge pattern, the photo-dielectric system has inherently high resolution since the picture charge pattern is read out directly as a video signal by an electron beam. Moreover, it offers real promise of providing response in various parts of the radiation spectrum in addition to the visible including infrared and ultraviolet with sensitivity better than standard photographic techniques.

Readout is accomplished by use of a finely focused electron beam which scans the charge pattern. It is then converted directly to a video signal for transmission to the ground. Readout can be accomplished at different speeds to compensate for various power and band-width requirements dictated by the nature of the space mission.

The flexibility of the system permits readout of the same image numerous times, if desired, by ground control. In the laboratory, the same image has been read out up to 100 times without serious degradation of quality. Yet, the image is erased completely, with no trace of "sticking," as the tape is flooded with electrons prior to exposure. Transistorization of the package results in minimum weight and low power requirements.

Since a high vacuum is essential to the operation of a photo-dielectric tape camera system, it is "at home" in the harsh environment of space. Also, dielectric tape is virtually unaffected by radiation thereby eliminating this hazard to ordinary photographic film. It is also reusable and serves as its own storage medium for remote picture-taking sequences.

To find out how RCA's new photo-dielectric tape camera developments can fill your requirements for space image-sensing systems, write to the Manager, Marketing, Astro-Electronics Division, Defense Electronic Products, Radio Corporation of America, Princeton, New Jersey.

And for a challenging, rewarding career in electro-optical systems development, apply to the Employment Manager, RCA Space Center, Princeton, New Jersey. All qualified candidates are considered regardless of race, creed, color or national origin.

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Defense Reveals Electronic Survey Result

Washington—Trends in electronic technology and problem areas in need of research effort are revealed by results of a recent Defense Department survey of 49 prominent engineers and scientists, many of them also top industry executives.

J. M. Bridges, chief of the Office of Electronics, Director of Defense Research and Engineering, wrote to the 49 top scientists and engineers requesting their views on what they considered to be:

- **Most important electronics research** areas in terms of military, economic and/or social progress.
- **Research areas most likely** to produce significant changes in the nation's military posture.
- **Most significant research work** being conducted by the respondent's own organization.

Comments of those surveyed, quoted without identification of the respondent, are contained in a recently issued report entitled "Important Areas of Electronic Research." Proprietary and classified information have been omitted. Here are a few representative views on subjects of defense/space technology interest:

- **Infallibility:** "We must attain a degree of infallibility in our warning and countermeasures systems far beyond present attainments . . . to avoid . . . [enemy spoofing of] our warning systems, we must continually seek and implement means of recognizing the 'fine structure' of radar returns and other target indications which permit us to distinguish decoys from warheads. This requires a degree of sophistication, a new depth of knowledge of what a target indication is, in finest detail. Multiple sensor observations is one approach, extreme resolution is another, and both require correlation techniques" (AW Sept. 25, p. 271).
- **Radiation environment:** "There is one overriding need which is the common denominator to all: that of continually emphasizing those portions of our research program which will lead to the functioning of military electronics in an enemy-produced nuclear environment" (AW Aug. 8, 1960, p. 58).
- **Optical masers:** "The ability of the optical maser (laser) to transform broadband energy into the energy of a single optical line makes it possible to concentrate the emergent coherent light to a fine focus and to achieve effective communication, point-to-point power transmission, or, by concentration of an adequate amount of energy, even the destruction of enemy missiles at relatively long range" (AW July 18, 1960, p. 96; Oct. 24, 1960, p. 75; Dec. 5, 1960, p. 92; Dec. 26, 1960, p. 73; Feb. 6, p. 34; Feb. 27, p. 61; July 24, p. 71).
- **Secure communications:** "The role of reliable, invulnerable and secure communications for command control in many of our defense systems cannot be over-emphasized. It is probably one of the weakest links in a defense system dedicated to reply retaliation. The decision to employ weapons or to cease fire . . . from a central command . . . to firing sites and battle zones should be both reliable and secure. Unfortunately, no such system exists today. Recently, developments in earth current communications have given promise . . . and if coupled with more conventional means . . . [could meet] military needs . . . There is the distinct possibility that shore-to-ship and ship-to-ship underwater communications may be advanced by an order of magnitude utilizing this technique. Also, the possibility exists of locating ships and submarines which are completely silent and protected against sonar detection" (AW June 26, p. 75; Sept. 25, p. 296).
- **Self-learning systems:** "Data handling is the key to improved military plans and operations. We cannot continue to be boxed in by the attainable complexity and speed of existing apparatus. Nor can we take the reliability risks . . . [when complexity is increased by] the next factor of 10 to 100 . . . The present effort to devise machines that learn [or at least significantly reduce the entropy of raw data and detect unspecified or unsuspected patterns in the data] is well worth expanding" (AW July 4, 1960, p. 72; Sept. 26, 1960, p. 83; Apr. 24, p. 69; Aug. 28, p. 98).
- **Bionics:** "The study of neural processes of living organisms could lead to breakthroughs in the computer and information handling field" (AW Oct. 3, 1960, p. 67; Feb. 20, p. 52).
- **Information storage retrieval:** "A . . . crucial research area is that of information retrieval and processing—the editing, classification, correlation and abstracting of data of all kinds. We now are, or soon will be, faced with the means of acquiring, transmitting, storing and processing huge quantities of information that we do not now know how to use effectively. Examples are library cataloging, patent searching, intelligence document files and cloud-cover pictures transmitted by the Tiros satellites" (AW Sept. 25, p. 296).
- **Superpower microwave generators:** "Development of sources with very high power generation capabilities in the microwave (and eventually the millimeter wave) range should open up new possibilities for various applications." Another respondent cautioned that "electron tube research must not be forgotten in the rush to solid-state components. The noise in electron tubes having crossed electric and magnetic fields is still not understood fully, and orders of magnitude improvement in signal-to-noise ratio may be possible."
- **Antennas:** ". . . any future long-range radar system necessarily will be of the phased-array type . . . The techniques are with us today [but] further research is needed in optimum designs and in the economical aspects of building such systems." Another respondent said: "A solution of the problems of phase control and stability for the operation of large arrays . . . is important" (AW Aug. 21, p. 54; Sept. 25, p. 296).
- **Materials technology:** "A very large part of what we are trying to do in electronics [and] all of the related sciences is materials limited . . . Better comprehension of materials at the structure-of-matter level has already produced today's semiconductor technology and atomic energy and can produce equally exciting additional breakthroughs." Another respondent said: ". . . stress on research on materials . . . has only recently been stressed and emphasized in its own right in the over-all Defense Department and national materials program. This emphasis certainly warrants continuing attention."
- **Inertial systems:** Studies "designed to explore the possibility that the properties [magnetic or electric moments] of atoms and molecules can be used to make very accurate gyroscopes and accelerometers." The respondent estimated it would be five years before such techniques might be available for application (AW Oct. 2, p. 23).
- **Solid-state:** "I consider that the most significant work we are doing is that related to understanding imperfections, generally the ones we don't want, in silicon. Most of the high cost of semiconductor devices and many of their limitations . . . arise from the fact that there are entities in the situation which one does not draw in an idealized diagram of the atomic constitution of the device." Another respondent said: "Ex-

URGENT: PACK

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Shrinking the size of modern electronic gear to simplify the nation's work in space explorations gets top priority at Sylvania Electronic Systems.

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How would such equipment perform in outer space? Laboratory tests show that circuitry employing Sylvania's microminiaturization techniques can survive and perform unattended for over 36,000 hours! What's more, these modules permit circuit stage interconnections *without the use of wires!*

Making advances that promote the nation's position in the race for space is just one of many areas of talent concentration among the scientists and engineers of the General Telephone & Electronics corporate family. The vast communications and electronics capabilities of GT&E, directed through Sylvania Electronic Systems, can research, design, produce, install, and service complete electronic systems. These systems cover the entire range from detection and tracking, electronic warfare, intelligence and reconnaissance through communications, data processing and display.

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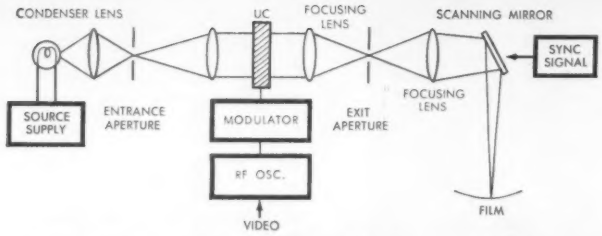

ON THE BEAM to improve the quality of infrared strip maps produced from taped video data, Bendix has developed an Ultrasonic Light Modulator under contract to the Air Force Rome Air Development Center. Using this device, reconnaissance information may be processed to preserve greater detail and facilitate more rapid interpretation. This device is an example of advanced optical and display techniques under development by Bendix engineers. Senior scientists and engineers are invited to join our advanced team. Write Personnel Director, Ann Arbor, Michigan. An equal opportunity employer.

Bendix Systems Division

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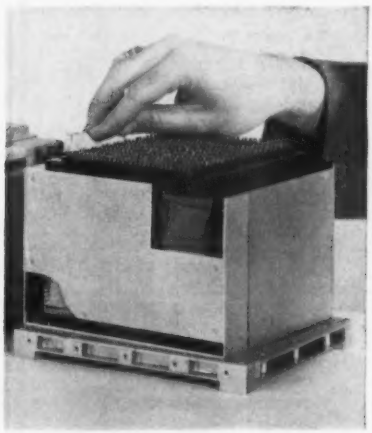
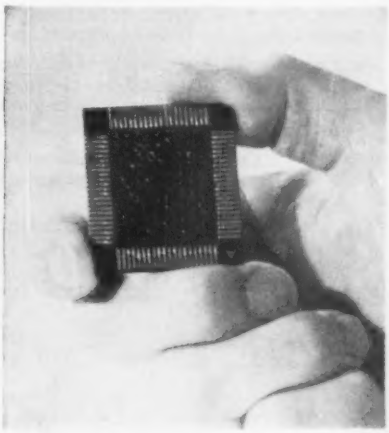
ploitation of recent discoveries in physics [such as the Mossbauer effect] could revolutionize many of our present concepts [for] guidance, time-keeping and amplification." Still another respondent points to the need for new techniques for attaching electrodes to semiconductor devices in a reproducible manner. The need will grow "as the complexity of solid circuits grows," he says. And still another said: "I am almost sure that transistors can be constructed so that it will be impossible to determine their life expectancy in less than a century [of testing]. This requires glazing the surface and careful elimination of mobile ions which can move about through the transistor, changing its electrode properties."

• **Micro-electronics:** "The attainment of techniques whereby enormously complex systems may be built in small sizes would revolutionize many military and non-military operations. Although a number of the techniques now being worked on are promising, there should be room for others; for example, atomic or molecular resonances varying from point to point in small cells. Clearly one of the most difficult and important problems is that of interconnection if it is to be done with flexibility with respect to various applications, not only because of the small size, but because of the tremendous numbers involved. Finally, a whole new approach to [equipment] synthesis in this field will be needed." Conflicting views were expressed on the concept of molecular electronics, and when it might first find application. One respondent predicted that molectronic blocks would be in mass production at low cost within five years. Another estimated that there would be no large scale applications for at least five years and probably more nearly 10 years (AW Feb. 8, 1960, p. 79; Mar. 7, 1960, p. 237; Mar. 21, 1960, p. 67; Apr. 11, 1960, p. 94; May 9, 1960, p. 107; July 4, 1960; p. 82; Sept. 5, 1960, p. 90; Oct. 10, 1960, p. 73; Oct. 17, 1960, p. 54; Oct. 24, 1960, p. 93; Jan. 23, p. 97; Feb. 27, p. 69; Mar. 27, p. 64; Apr. 3, p. 77).

• **Atmosphere and propagation:** "Low power VHF propagation over hundreds to thousands of miles by means of predictable elevated ducts in large areas of the oceans has been established. Exploration of these ducts is the prelude to meteorological knowledge from a new and perhaps bountiful source and to exploitation for communication certainly, for radar probably." Several respondents also called for exploitation of the whistler mode of propagation of very low frequencies through the ionosphere. Another said: "We now have without our capability the means for modifying [at least temporarily] the physical characteristics of the upper atmosphere in ways which are useful . . . for both military and civilian applications. Still another said that ionospheric propagation research at medium, high and ultra high frequencies is "essential to boost-kill anti-missile systems as well as to communication satellites.

A copy of the full 95-page survey report, "Important Areas of Electronic Research," identified PB-171-881, can be obtained for $2.25 from the Office of Technical Services, Commerce Department, Washington 25, D. C.



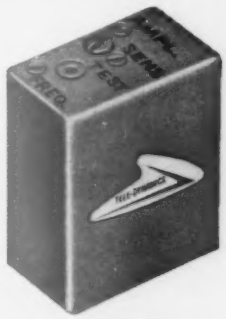


Digital Computer Has Space Application

All-magnetic digital computer for space vehicle guidance and control is expected to be far more reliable and resistant to radiation damage than a computer using semiconductor devices, according to Sperry Gyroscope Co. which developed the device. Computer (left) can perform more than 12,000 computations per second. It weighs 19 lb., occupies less than one-half cubic foot and consumes 90 watts. Computer uses "dynamic logic" so that it consumes power only when making computations. Arithmetic unit (right) consists of tiny interwoven ferrite cores. Magnetic memory used for storage of operating instructions can operate over temperature range of —67F to 250F, Sperry says.

TELEMETRY BY TELE-DYNAMICS

Voltage Controlled Oscillator



Positive, reliable oscillator performance is essential to your aerospace telemetry needs. And Tele-Dynamic's newest—the Type 1270A Voltage-Controlled Oscillator is representative of Tele-Dynamic's creative effort in the complete telemetry field.

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Environmental characteristics include thermal stability of ± 1.5% design bandwidth from —20°C to +85°C, unlimited altitude, 30G random vibration and 100G acceleration and shock. The 1270A weighs less than two ounces and has a volume of two cubic inches.

For detailed technical bulletins, call the American Bosch Arma marketing offices in Washington, Dayton or Los Angeles. Or write or call Tele-Dynamics Division, American Bosch Arma Corporation, 5000 Parkside Avenue, Philadelphia 31, Pa. Telephone TRinity 8-3000.

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Dynamometer Test Systems...Evaluation of dynamic characteristics of gyro spin motors; microsyn transducers as used in a closed-loop torque-nulling system. Typical systems include excitation and power supplies, servo/electronics and controls. (Dunn Bulletin T1150)

Inertial Test Systems...Test and evaluation of dynamic and static performance of complete inertial and gimbal platform guidance systems; substantial experience and background in inertial packages utilizing HIG gyros, PIG & PIGA units, stable platforms, and related items. (Dunn Bulletin T818/T918)

Dunn Engineering participation in Defense Department programs includes Talos, Polaris, Sparrow, Hawk, Discoverer, Midas, Atlas and Saturn. Close customer liaison, both in proprietary products and custom-specification-designed equipment, is a basic tenet of Dunn and results in lower costs and faster delivery for Dunn customers.

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System Monitors Bioastronautic Data

By Barry Miller

Van Nuys, Calif. – Central data gathering system capable of remotely monitoring the physiological reactions of a man or simian in aerospace environments and then storing or displaying data for inspection by observing physicians is being built here for the Bioastronautics Laboratory, Air Force Missile Development Center, at Holloman AFB.

Intended to handle up to 33 channels of both physiological and environmental information gathered from live subjects and ambient conditions in an environmental chamber for periods ranging to two weeks, the system is scheduled for delivery to Holloman next spring. Spacelabs, Inc., is developing it under a $290,000 Air Force contract.

The system is referred to as VIDAT (Viability Data Acquisition System). It is expected to aid scientists at Holloman in their efforts to evaluate space vehicles, to conduct research into the effects of abrupt acceleration and deceleration on animals and to measure and determine pathologically significant cosmic radiation.

VIDAT will display analog and digital data collected by sensors attached to the bodies of subjects and will be able to store it for computer input and later playback.

System's Value

Principal value of the system, according to Spacelabs, will rest in its ability to:

- **Display medical data** in forms conveniently read and interpreted by medical officers.
- **Provide real time storage** of analog data (storage of up to two weeks' data) and real time display of analog data.
- **Obtain compressed** digital samples in computer format for direct input to the base's Univac 1103A computers.
- **Display telemetry tapes** acquired from other tests as the system is compatible with standard (FM/FM) telemetry.

The VIDAT system as it is now envisioned by Spacelabs will contain three parts. These are:

- **Physiological and environmental** data sensors, signal conditioners and amplifiers, all to be located inside the environmental chamber at Holloman. Physiological sensors will be situated on the subject's body and the signal conditioners-amplifiers inserted in vests (four will be supplied for men; four for chimpanzees). Five commercially available transducers will be used to monitor the chamber's ambient temperature, pressure, oxygen, oxygen partial pressure, carbon dioxide partial pressure and relative humidity.
- **Data multiplexing** and transmission system will be located in a rack outside the chamber. Inputs for multiplexing will be cabled through an umbilical arrangement from the test chamber. The company hopes to eventually do away with the cabling by substituting a radio transmission system, mounted on the subject's body, although this is not included in the present Air Force contract.
- **Data conversion,** display and magnetic tape recording (both analog and digital) at a central monitoring station situated about a quarter of a mile from the chamber.

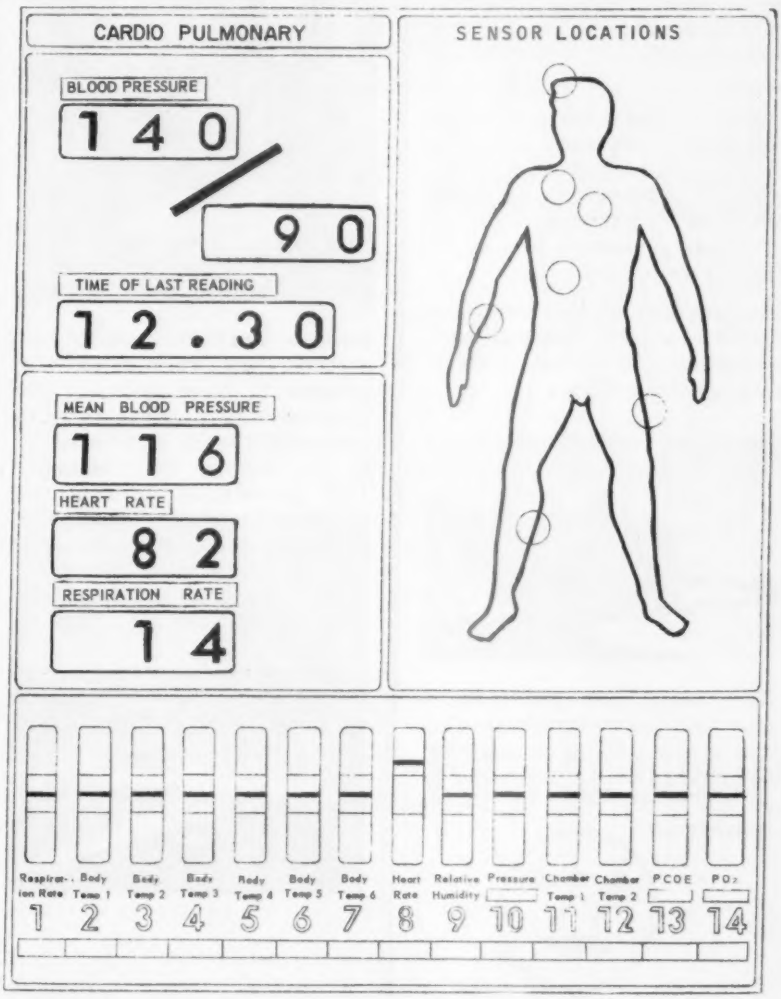
Spacelabs, like many other organizations concerned with instrumenting live subjects in simulated and actual aerospace environments, regards the need for suitable, reliable sensors as a key problem in gathering useful physiological data. This problem is compounded, the company says, by the requirement that sensors remain attached to and continue to operate satisfactorily on the animal's body for periods up to two weeks.

Recent Improvements

Concentrating on sensor design for two years, Spacelabs will incorporate recent improvements in sensor design into VIDAT. Typical of the sensors it expects to use for this system is an electro cardiogram (ECG) electrode consisting of a dry wire mesh backed by a sponge to hold it in close contact with the body.

Physiological parameters which are to be measured include:

- **Respiration**—Chest band with strain



DISPLAY OF PHYSIOLOGICAL and environmental data will include a cardio pulmonary and sensor location chart which provides digital indication of key physiological parameters and signals when reading exceeds prescribed limits. Circles on body outline will contain numbers identifying specific location of body sensor.

Westinghouse Electric Power Systems

Electric power is the lifeblood of flight vehicles.

Instrumentation, control, guidance and navigation, communication, human comfort—indeed virtually every function in every modern transport, military or civil aircraft, missile or space vehicle depends on an electric power system.

For many years Westinghouse has specialized in the design and production of such systems. These have ranged from wind-powered generators of World War I aircraft to today's superb brushless generators and static control equipment.

Headquarters for this important activity is the Westinghouse Aerospace Electrical Department at Lima, Ohio.

Here more than 1600 skilled men and women design, develop and produce airborne electrical equipment which has achieved an unrivaled record of trouble free service.

Here, too, skilled scientists and engineers are working on new systems to meet electrical requirements of flight in years to come. This work is directed by R. W. Esarey, AED manager (left seated), A. L. Paquette, marketing manager (seated), J. D. Miner, engineering manager, and F. W. Lowry (right standing), manager of advanced systems applications.

One of the most successful flight proved electric power systems ever built consists of 30 and 40 KVA brushless generators and static control apparatus for the Boeing commercial Jetliners. Mean time between removals is in thousands of hours — a dependability record many times better than that of ordinary brush-type generators.

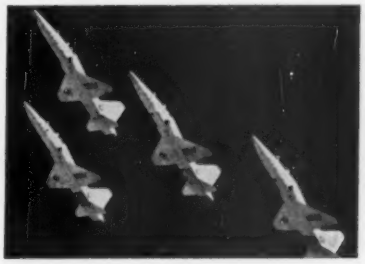
Longer service life and greater reliability results from the elimination of commutators, carbon brushes, and collector rings. These are replaced by a single rectifier stack consisting of high-temperature silicon diodes. Westinghouse research in semiconductors made this important advance possible. Results: greater reliability, increased TBO, reduced maintenance costs.

Serve the Advancing Needs of Flight

Westinghouse brushless generators are standard on Boeing 707s and 720s. The coming 3-engine Boeing 727, above, will have a new Westinghouse starter-generator system using the basic, time-proved brushless design.

The largest rated brushless air-cooled generators ever produced supply electric power for the Air Force B-52H, built by Boeing. These Westinghouse generators are rated at 120 KVA.

Oil-cooled brushless generators are provided for two major high-performance military aircraft, the Air Force B-58 "Hustler," built by Convair, and the Navy A3J, built by North American Aviation.



Another military aircraft, the sleek Air Force T-38 Jet Trainer, built by Northrop, is equipped with Westinghouse 8 KVA brushless generators.

Space electric power systems also are a major activity at Westinghouse. The Air Force manned space glider, Dyna-Soar, to be built by Boeing, will have a new brushless generator and static control equipment to supply vital electric power.

For the future, thermoelectric, thermionic, solar cells of high efficiency, magnetohydrodynamic and other advanced systems are being developed to provide electric power for space as well as non-space applications.

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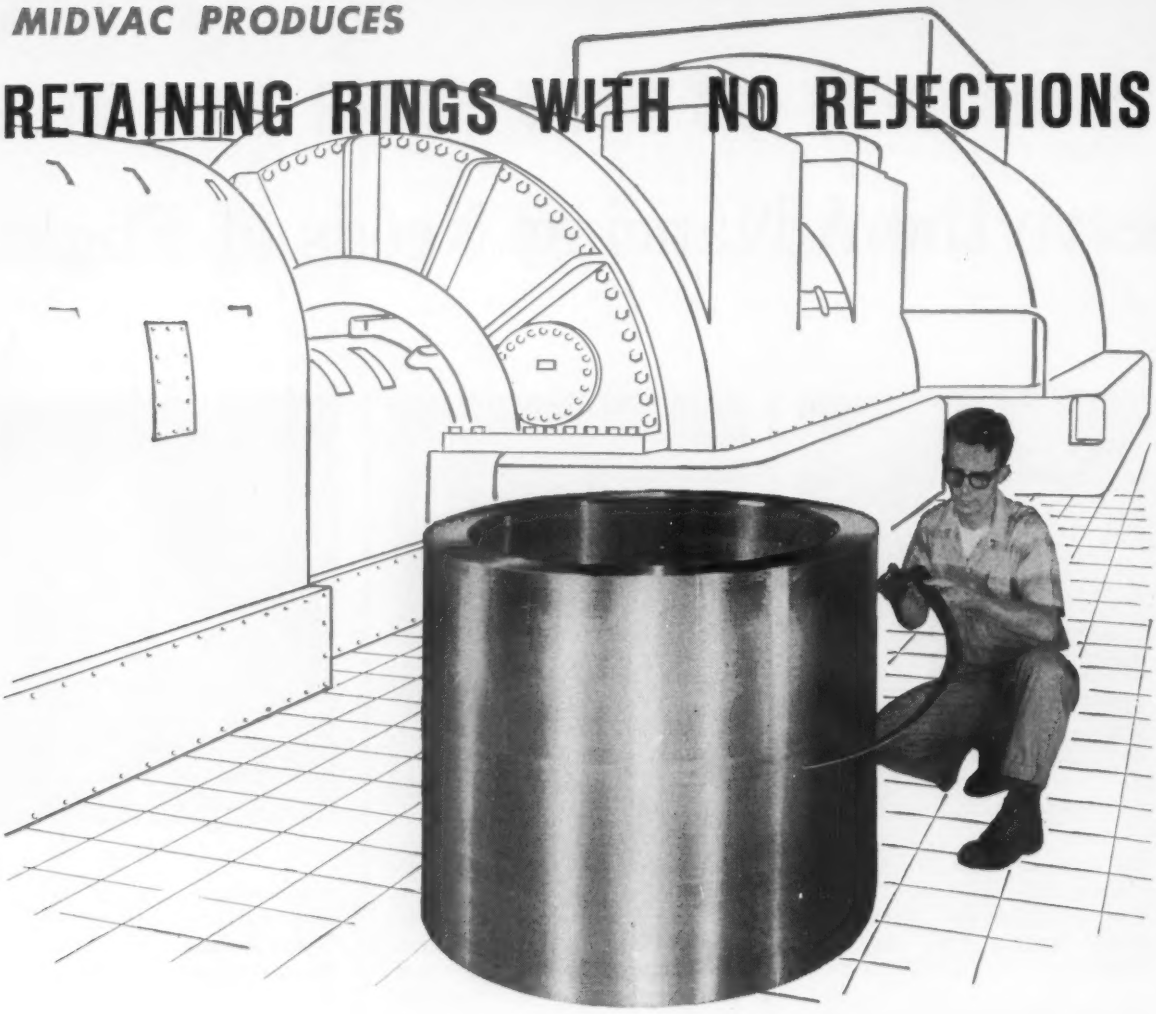

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The Midvac Process eliminates atmospheric contamination, ingot soundness is improved, segregation is reduced, workability is increased and product quality is stepped up. Midvac Steels are offered in many alloys as billets or forgings to meet the most critical design specifications. Write for detailed metallurgical case history book to . . .

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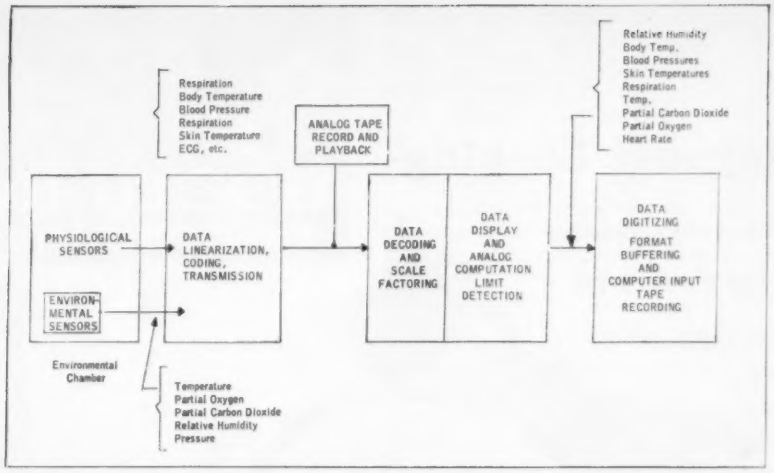

VIABILITY DATA ACQUISITION and display system, being developed by Spacelabs, Inc., for Bioastronautics Laboratory, Holloman AFB, can acquire physiological data from either human or simian subjects during tests of up to two weeks in environmental chamber. Physiological and environmental data can be acquired, coded and sent to display and recording center. Data is then displayed in analog and digital form, tape recorded in analog form and digitized and translated for computer tape inputs.

gage will be employed to provide complete respiratory waveform.

• **Skin and deep body temperatures**—Temperatures will be monitored by thermistor sensors.

• **Electrocardiogram**—ECG will be displayed on scope or strip chart.

• **Blood pressure**—Conventional medical occluding cuff technique, with the cuff around the subject's leg is the likely choice for these measurements.

• **Heart rate**—This will be determined by linking ECG to a heart rate computer (counter) which counts characteristic spikes in the ECG to indicate heart rate. Respiration rate similarly will be obtained from the respiration waveform.

Under a separate contract from Edwards AFB, Spacelabs is developing an unusual technique of obtaining blood pressure—a technique which it expects to propose as an additional monitoring method for the VIDAT system. This technique, called pulse wave velocity measurement, promises to do away with the need for occluding a limb and may provide a continuous (as distinct from the sampled readings obtained by the occluding cuff method), dynamic measurement of blood pressure. It also might indicate changes sooner than would the conventional occluding technique.

Technique Explained

This technique involves measurement of the velocity of a sound wave generated as the heart valves close. The wave travels down the aorta at a velocity which is nearly linear with blood pressure over the central portion of the blood pressure range. By measuring this time period with the aid of a characteristic spike in the ECG as a reference, velocity of the wave can be determined, and from it blood pressure.

Once necessary data is obtained from physiological and environmental sensors within the chamber, the data is linearized, coded and sent over the ¼-mi. path to a video, timing and voice patch panel. Data signals are multiplexed into standard telemetry form so the processing portion of the system can use standard techniques of handling gathered data and also be able to accommodate other telemetry tapes.

The selected frequencies of voltage controlled oscillators in the transmission rack are kept low (below 14.5 kc.) which enables data to be recorded slowly in analog form on an Ampex 600 tape recorder.

Coded data received at the video patch panel is fed into a discriminator rack which supplies scale factored analog voltage outputs. Some of these signals are passed into special counters where heart rate is determined from ECG and a time reference, systolic and diastolic blood pressure from cuff pressure and Korotkov sound, etc.

These signals as well as original analog data (such as skin temperatures, relative humidity, ambient and body temperatures) are transmitted to a digitizer in which analog-to-digital converters transform data into digital form. These inputs are sampled at low rates (one per 15 sec., one minute or two minutes). Word blocks are made for 727 computer tapes which serve as input for 1103 computer.

In the digitizer, binary data is converted to decimal form and displayed in the console as real, scale factored, linear

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NEW Low Level Subcarrier Oscillator

The Type 1274A Low Level Subcarrier Oscillator is an outstanding member of Tele-Dynamic's new line of transistorized telemetry components for today's aerospace applications.

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For detailed technical bulletins, call the American Bosch Arma marketing offices in Washington, Dayton or Los Angeles. Or write or call Tele-Dynamics Division, American Bosch Arma Corporation, 5000 Parkside Avenue, Philadelphia 31, Pa. Telephone: TRinity 8-3000.

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This Baby is Bayonet-Locking

Meet DTK...the best little bayonet-locking electrical connector available today. DTK is short for Deutsch Tri-Kam and refers to the triple cam coupling design that assures fast, positive engagement and lock. As a direct descendant of MIL-C-26482, this baby is interchangeable with existing MS 3110 and 3116 series connectors. The DTK also inherits many desirable features from its Deutsch ancestors including superior silicone inserts and MIL-C-26636 crimp-type contacts that are insertable and removable with military standard tools. Color-keyed mating indexes and 7-point inspection for lock, make this latest generation connector a cinch to couple, even in remote locations. For more vital statistics on the latest addition to the Deutsch family, contact your local Deutschman today or write for Data File **H-10.**

DEUTSCH

Electronic Components Division • Municipal Airport • Banning, California

ADVANCED SPECIFICATION MINIATURE ELECTRICAL CONNECTORS

DEUTSCH
CONNECTORS

24 Hour
Delivery
COAST-TO-COAST

- **DM Series**—push-pull, meets Mil-C-26482
- **DS Series**—push-pull, insertable, removable, crimp contacts
- **DTK Series**—bayonet lock, meets or exceeds applicable requirements of Mil-C-0026482A
- **DRS Series**—rectangular rack and panel, advanced application performance
- **DC Series**—push-pull, environmental, crimp-type RF connector
- **DM and DH Hermetics**—glass to metal seals, leak proof glass to metal seals

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DEUTSCH CONNECTOR DIVISION
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TWX: GREAT NECK, NY 639

DALLAS
ARCO ELECTRONICS, INC.
1339 Crampton St.
Dallas 7, Texas
Riverside 8-0648
TWX: DL 526

LOS ANGELES
ARCO CAPACITORS, INC.
1548 So. Robertson Blvd.
Los Angeles 35, Calif.
Crestview 1-1151
TWX: BV 7012

numbers, corresponding to the quantitative values of physiological and environmental factors physicians are accustomed to seeing.

A cardio-pulmonary display panel is included in the display console. It provides the test monitor with necessary information to assure him of the safety of the test subject. Information is presented in clinical form and includes systolic and diastolic blood pressure, heart and respiration rates, temperature and possibly mean blood pressure. A pictorial outline of a human body with sensor locations indicated aids the monitor in pinpointing spots of concern.

Some data from analog data patch can be displayed on xy recorders and/or a scope.

One problem encountered by the company in this work was in presenting skin and body temperatures to the high accuracy (within 1%) required by the Air Force. Because even a slight error in presentation of human temperature could cause unnecessary alarm, special temperature wires from the sensors provide signals to directly drive the digitizer and digital display.

FILTER CENTER

▶ **Fuel Cells for Apollo Electrical Power**—Fuel cells probably will be employed as the primary source of electrical power for the manned Apollo lunar spacecraft because of expected ability of these electro-chemical sources to supply kilowatt level power for periods of several weeks. National Aeronautics and Space Administration has specified that Bacon-type fuel cells should be employed in Apollo spacecraft proposal designs but it gave prospective prime contractor option of quoting an alternative, comparable power source.

▶ **Flight Test for Fuel Cells**—Two 10-lb. ion exchange membrane fuel cell batteries will be flight tested in a Blue Scout vehicle next summer in an effort to determine feasibility of removing condensation from the batteries over a long period of time without flooding in zero gravity conditions. Test, being conducted by USAF's Aeronautical Systems Division, aims at putting a complete fuel cell capsule (two batteries plus instrumentation) in a 30-day, 300-mi. orbit. Batteries to be made by General Electric's Aircraft Accessory Turbine Department will be exercised from the ground by turning them on and off.

▶ **Electrical Power From Bacteria**—Batteries supplying reasonable levels of power by converting life energy of bacteria into electrical power are being developed by Magna Products, Inc., Anaheim, Calif. In one concept bacteria with an appetite for specific minerals are placed together with them in a container of sea water. As the bacteria eat the minerals, the latter's electrical state changes. This change of state, occurring during metabolic processes, is then the source of current since it creates an electron movement. In another type of battery, somewhat akin to the photovoltaic process used in conventional solar cells, bacteria of certain type release energy in response to certain wavelengths in the solar spectrum.

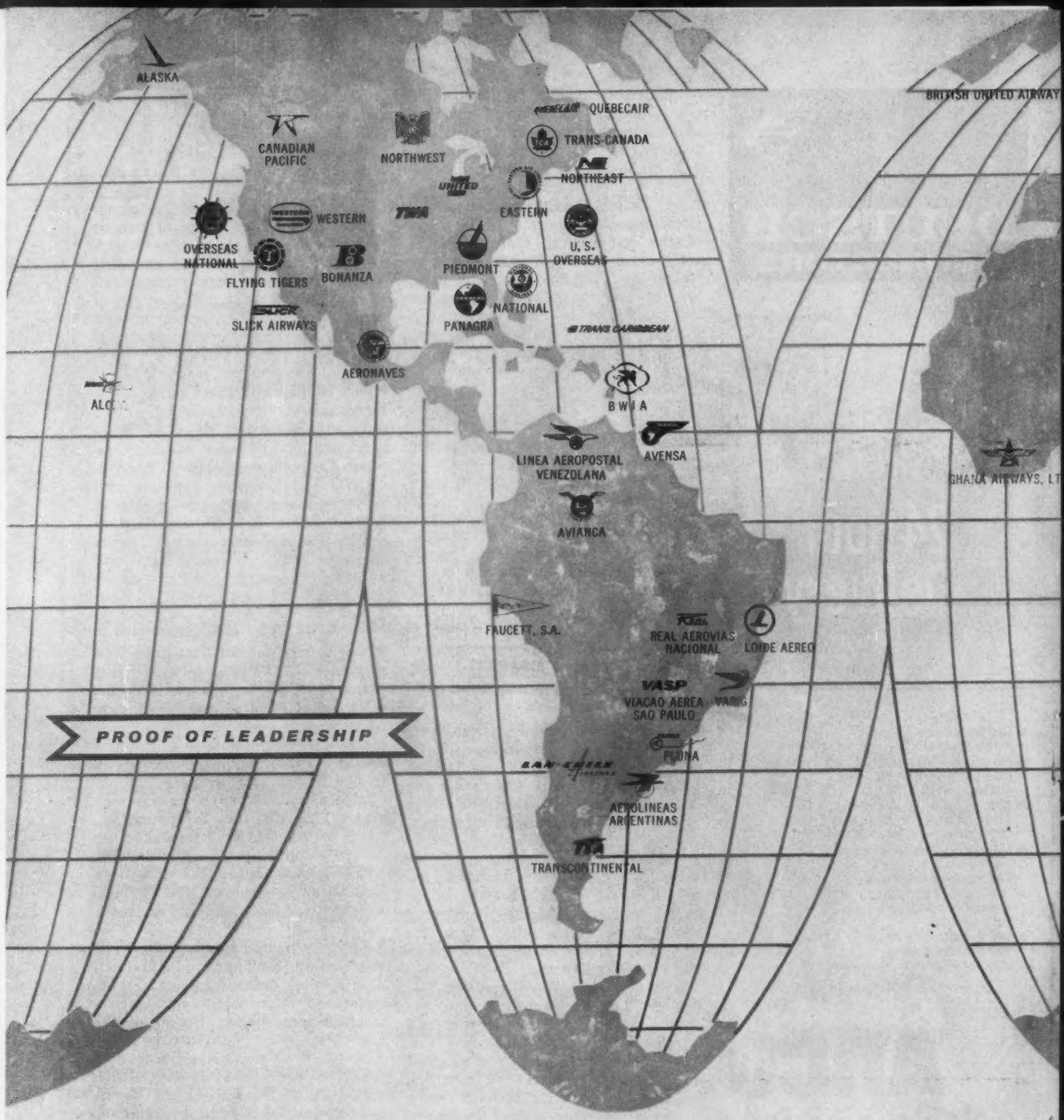
▶ **New Millimeter Tubes Coming**—New higher power tubes operating in the millimeter wavelength region are being developed under Rome Air Development Center sponsorship. These include a backward wave oscillator with a continuous-wave output of 20 watts at 8 mm. and a 20% tuning range, a similar tube with an output of 2 watts at 4 mm. and a 5% tuning range, and a Carcinotron operating at 2 mm. which is expected to have an output of about 1 watt.

▶ **New Laser Materials Available**—Two companies have announced new materials for use in optical masers. They are:

- **Valpey Crystal Corp.**, Holliston, Mass., reports a ruby rod with sapphire overlay encircling the body of the ruby over its entire length, providing increased capture cross section for greater efficiency and improved cooling.
- **Semi-Elements, Inc.**, Saxonburg, Pa., has developed and is in production on barium fluoride doped with uranium which has an output wavelength of 26,000 angstroms, in the infrared region.

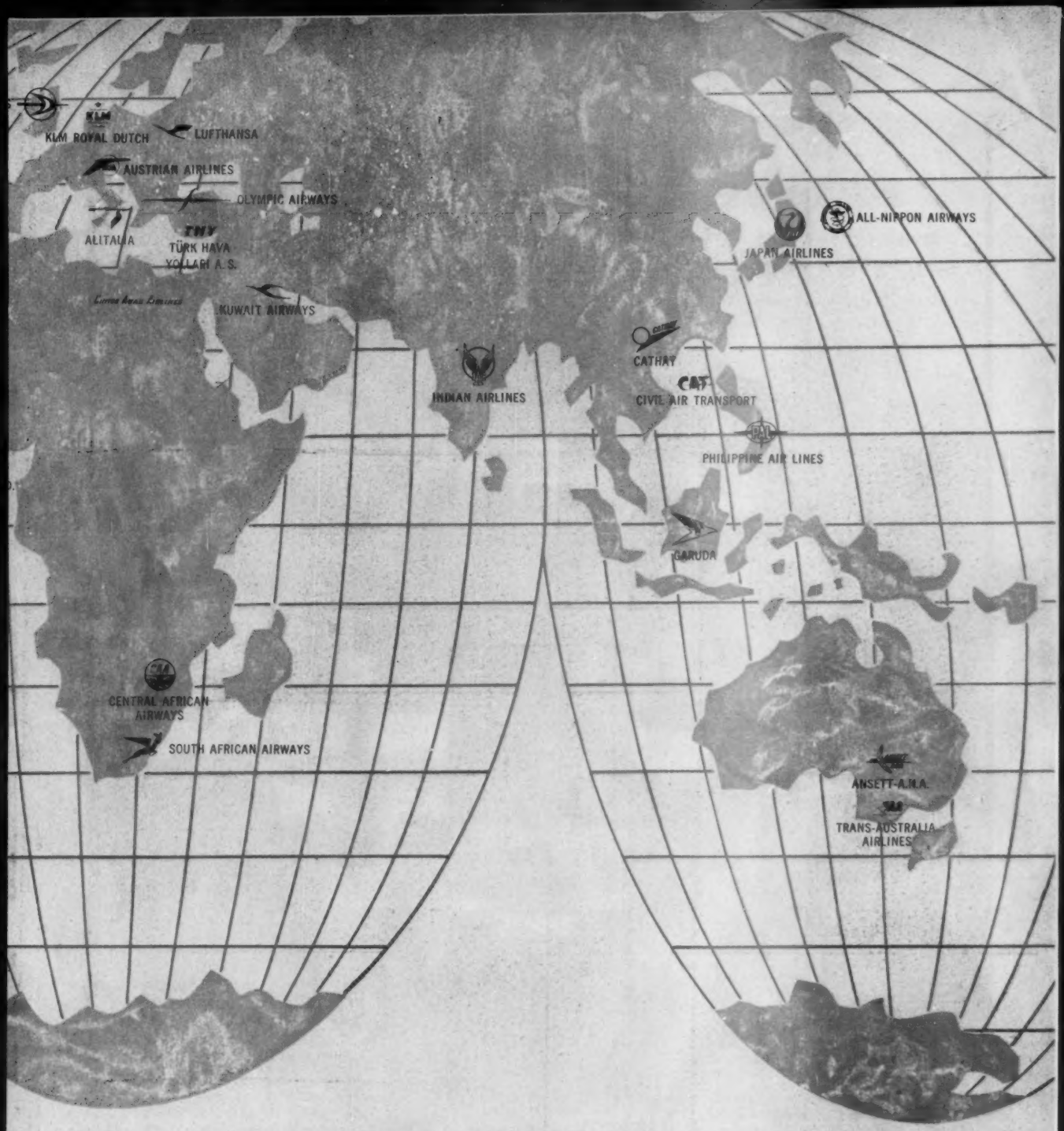
▶ **Energy Conversion Abstracts Available**—Report containing 548 abstracts of articles on direct energy conversion, including thermionic, photoelectric, magnetohydrodynamic, electrochemical and energy storage, prepared by Naval Research Laboratory, is available from Office of Technical Services, Commerce Dept., Washington 25, D. C. Report, entitled "Direct Energy Conversion Literature Abstracts," identified as AD-255-294, is priced at $2.75.

▶ **Supersonic Transport Problem**—Obtaining an accurate heading reference in supersonic transports designed to fly at Mach 3 may be a problem because of stainless steel construction required at such speeds which will prevent use of magnetic compass for heading and slaving of directional gyro. However, progress during past decade in slashing drift of unslaved gyros suggests that gyros with sufficiently low drift may be available by the time the need arises.

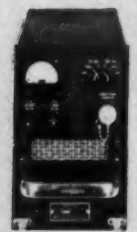


Bendix Weather Radar

. . . plus hundreds of privately owned business aircraft— *More than 2000 aircraft the world over enjoy its dependable protection. This is the best proof we know that Bendix® RDR-1 Airborne Weather Radar Systems provide more of everything that aircraft operators and pilots want…reliability, accuracy, and long range, wide area coverage. With new "bright display" indicators, scope pictures can be viewed easily even in brightly sunlit cockpits. Bendix systems are geared to do the whole job, both weather avoidance and ground mapping, and to do it with complete dependability. For full details, write Bendix Radio Division, Avionic Products, Baltimore 4, Maryland.*



Flies with 55 Airlines



RDR-1D
Transmitter/
Receiver

SYN-1B
Synchronizer/
Power Supply

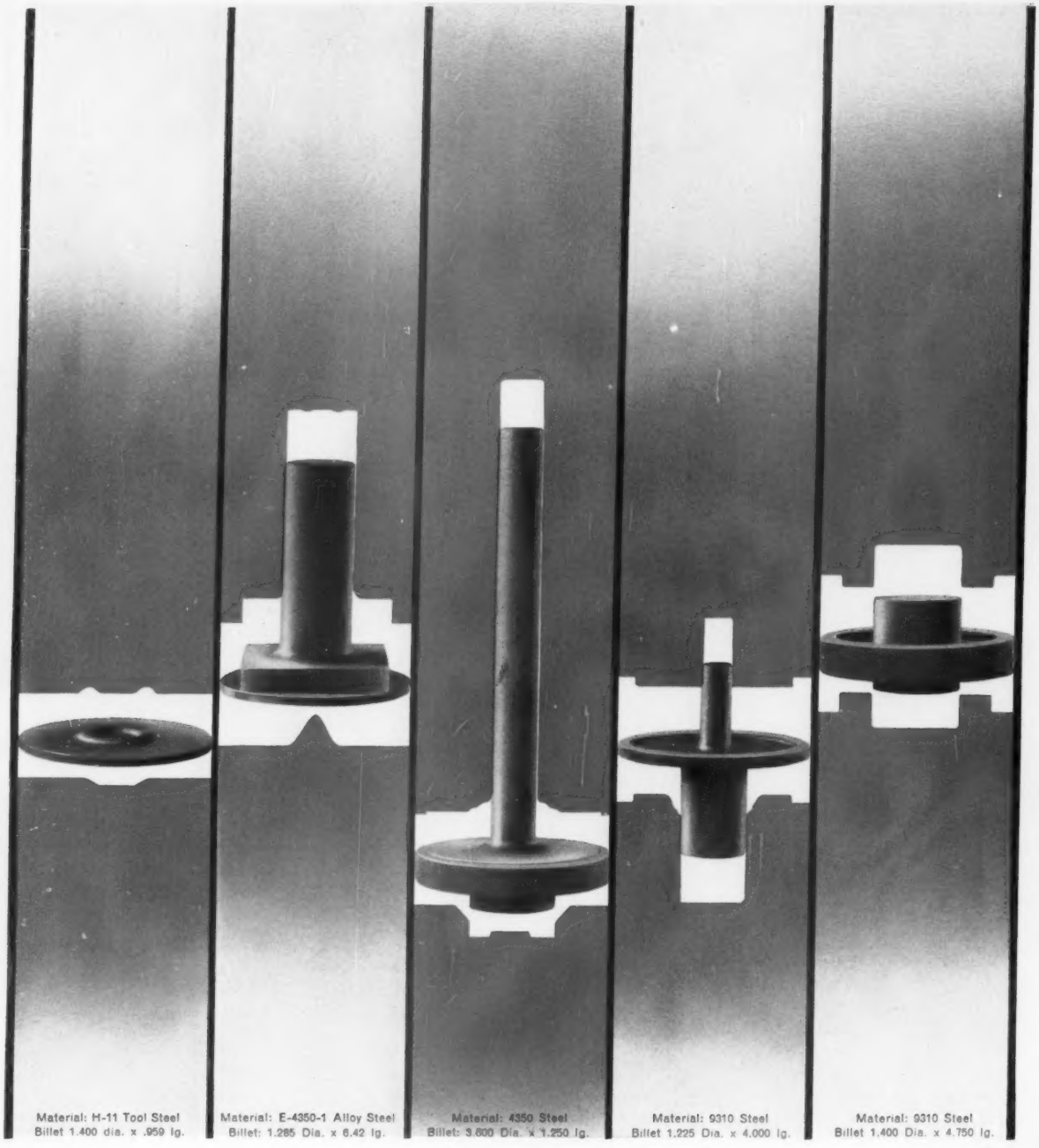
ANT-1G
Antenna

CON-IL-4
Control Unit

PPI-1E Bright
Display Indicator

THE Bendix CORPORATION

Bendix Radio Division


Material: H-11 Tool Steel
Billet 1.400 dia. x .959 lg.
Material: E-4350-1 Alloy Steel
Billet: 1.285 Dia. x 6.42 lg.
Material: 4350 Steel
Billet: 3.600 Dia. x 1.250 lg.
Material: 9310 Steel
Billet 1.225 Dia. x 4.000 lg.
Material: 9310 Steel
Billet 1.400 Dia. x 4.750 lg.

High-Energy Rate PRODUCTION ABILITY in one dynamic stroke! In this advanced, highly technical field, DYNAPAK high-energy rate metalworking equipment maintains consistent leadership through proven production ability. In support of this recognized position, illustrated above are forgings from BENDIX CORPORATION-UTICA DIVISION, where DYNAPAK is demonstrating its performance reliability in day-after-day production runs. DYNAPAK one-shot forging, extruding and metals compaction equipment increases savings, improves metal properties and reduces waste material. Closer tolerance controls, and the low micro finish of the "as forged" parts, are distinct advantages in DYNAPAK metalworking machines. Conventional or exotic materials, simple or complex shapes . . . DYNAPAK has few limitations. DYNAPAK metalworking machines are capable of making a part — in one stroke — that can be put to use with little or no machining. Apply DYNAPAK to your metalworking operations — it's the only *really new* proven concept in the industry.

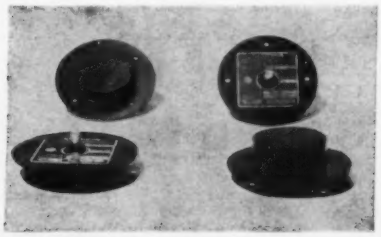
Write for complete information to: Advanced Products Department, P.O. Box 6231, San Diego 6, Calif.

GD

GENERAL DYNAMICS | ADVANCED PRODUCTS DEPARTMENT

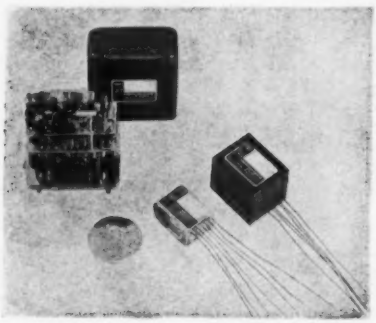
NEW AVIONIC PRODUCTS

• **Cavity antenna,** model ACST-1A, a flush-mounted, airborne S-band cavity antenna operates over the 2.75 to 2.95 kmc. frequency range, has a vswr of less than 1.65 at continuous tempera-



tures up to 250F. Complete antenna weighs less than 8 oz., has an aperture less than 3 in., and efficiency in excess of 90%. Radiation patterns are similar to those of a monopole. Manufacturer: Canoga Electronics Corp., 15330 Oxnard St., Van Nuys, Calif.

• **Ultraminiature servo amplifiers,** models 502 (2 watt), 504 (4 watt), 510-2 (10 watt), and 510-2-3 (10 watt), were designed for applications requiring lightweight, small size servo amplifiers. Model 502 (center of photograph)



weighs ½ oz., occupies 0.42 cu. in., is completely potted, and delivers its two watts into a size 5 servomotor. Weight of three other amplifiers is 1.46 oz., 4.75 oz., and 1.46 oz. respectively. Amplifier voltage gain is 1,000, power requirement is 28 v.d.c. and each unit operates at 400 cps. plus or minus 20 cps. Manufacturer: General Precision, Inc., Librascope Div., Glendale 1, Calif.

• **Germanium transistors,** types 2N1960 and 2N1961, electrically similar versions of 2N781 and 2N782 epitaxial germanium diffused-base mesa units, respectively, packaged in company's pancake package which provides a 60% saving over conventional industry TO-18 standard. These transistors are small signal devices with maximum turn-on time of 60 nanosec; maximum turn off of 50 nanosec. Maximum storage time is 20 nanosec. Prices in quantities up to 99 for the 2N1960 and 2N1961 are $15.00 and $10.00 each, respectively and in quantities from 100 to 999 are $10.00 and $6.85, respectively. Manufacturer: Sylvania Electric Products, Inc., 730 Third Ave., N. Y. 17, N. Y.

• **Precision potentiometer,** model 3500, a 10-turn unit which can provide resistances up to 250,000 ohms in a 1-in. long, ⅜-in. dia. case. Pot is guaranteed to meet cycling humidity specifications. Resolution is 0.03 to 0.01%, linearity plus or minus 0.25% standard and power is rated at 2 watts at 70C. Price is under $10.00 in average quantities. Manufacturer: Bourns, Inc., Trimpot Division, 6135 Magnolia Ave., Riverside, Calif.

• **Power triodes,** a line of high-power bias triodes, will permit bias power

supply to be eliminated in simplifying transmitter circuit designs. In grounded-grid circuits, power gains of 20 have been achieved. Peak envelope powers range from 500 to 20,000 watts. Manufacturer: Eitel-McCullough, Inc., San Carlos, Calif.

• **Hall-Effect sensing device,** models BH200 and BH203 for measuring magnetic fields. Model BH200, transverse field sensing device, measures ¼ in. in length, 0.13 in. in width and 0.019 in. in thickness and is furnished with 7½ in.

leads. Active semiconductor area is 80 by 180 mils. Axial field BH203 is 0.195 in. in diameter, ⅛ in. in total length and has 14 in. long copper leads. Priced at $32.00 each, devices may be obtained from manufacturer: Semiconductor Division, F. W. Bell, Inc., 1356 Norton Ave., Columbus 12, Ohio.

CRYOGENICS

new/efficient 175 Liter Liquid Hydrogen Dewar

Here is the first commercial 175 liter liquid hydrogen dewar that eliminates the conventional, cumbersome liquid nitrogen protective shield. A permanent, high vacuum is used in conjunction with Cryenco-Lamina insulation—giving efficient, long storage time. H_2 boil-off is less than 3% per day. Dewar is equipped with fail-safe devices. Price: 1-2—$1473.00; 3-6—$1398.00, each. 20" O.D. x 61½"; tare wt. 180 lbs.; ASME; ICC-4L. For large capacity, convenient handling of (1) H_2 in your laboratory, write for catalog sheet.

RESEARCH AND OPERATIONAL EQUIPMENT

Cryenco manufactures a large line of standard cryogenic "hardware"—the dewar above is an example—also cryovalves, tanks, cold traps, transfer lines, cryostats. Engineered products include He-H_2 refrigerators, purifiers, liquefiers; ground support and flight equipment; accelerator equipment. This equipment is designed to free physicists and engineers for fundamental work. Write for complete catalog.

CRYENCO

CRYOGENIC ENGINEERING COMPANY
208 W. 48TH AVE. • DENVER 16, COLO.
Low Temperature, High Vacuum Equipment and Engineering

KNOW YOUR ALLOY STEELS . . .

This is one of a series of advertisements dealing with basic facts about alloy steels. Though much of the information is elementary, we believe it will be of interest to many in this field, including men of broad experience who may find it useful to review fundamentals from time to time.

Cold-Finishing of Alloy Steels: The Effect of Cold-Drawing

The cold-drawing of alloy bars was discussed in general in the advertisement prior to this one. Here, we explain the effect of cold-drawing.

During the cold-drawing process, certain changes take place both in the steel structure and in mechanical properties. There is a slight increase in tensile strength, compared with a substantial increase in yield point, and a decrease in ductility. These properties make possible the production of small parts which require the greater strength necessary for certain automatic-machine forming operations, and a machine finish superior to hot-rolled material. Naturally, the beneficial effects of alloy steels are attained in the subsequent heat-treatment of parts.

Cold-drawing results in bars free from scale, accurate to shape, and within close tolerances. These bars are ideal for automatic machining, since the elimination of scale is conducive to long tool life, and the accuracy of shape and close tolerances permit the bars to pass freely through the feed mechanism of the "automatic." Moreover, the cold-drawn finish and tolerances may be such that machining can be eliminated in some areas of the finished part. For example, nuts and bolts, produced from hexagon alloy bars, require no machining on the hexagon sections.

Continuous roller hearths and car-bottom furnaces of both standard and controlled-atmosphere types are used for special treatment of alloy bars before cold-drawing. Thermal stress-relieving can be used to reduce residual stresses in the steel caused by the cold-drawing process, which alters the mechanical properties, depending upon the temperature used.

If you would like more specific details about the chemical composition or mechanical properties of cold-drawn alloy bars, and the results that you can expect, by all means consult our technical staff. Bethlehem metallurgists will gladly help you work out any problem, without cost or obligation on your part.

In the next advertisement in this series, we will discuss the turning and grinding of alloy steel bars.

Remember that Bethlehem produces a complete range of cold-drawn alloy steel bars in rounds, hexagons, squares, or flats, in standard, odd, decimal or metric sizes, as well as special sections. We also make the full range of hot-rolled AISI standard alloy steels, special-analysis steels, tool steels, and all hot-rolled carbon grades.

This series of alloy steel advertisements is now available as a compact booklet, "Quick Facts about Alloy Steels." If you would like a free copy, please address your request to Publications Department, Bethlehem Steel Company, Bethlehem, Pa.

Steel

for Strength . . . Economy . . . Versatility

BETHLEHEM STEEL COMPANY, BETHLEHEM, PA. *Export Sales:* Bethlehem Steel Export Corporation

BETHLEHEM STEEL

BETHLEHEM STEEL

TRACE Monitors Titan I Base Progress

Dallas, Tex.—Fast-response data collection and reporting system weekly monitors in detail the construction of Martin Titan I intercontinental ballistic missile bases and also "weighs" the information to provide a true picture of the value of the work accomplished.

Built around an International Business Machines 704 computer and data processing system, TRACE (Temco Reporting and Current Evaluation) is administered under contract by Ling-Temco-Vought, Inc., from the U. S. Army Corps of Engineers Ballistic Missile Construction Office, Los Angeles.

For BMCO, the reporting system covers 16,000 work items involved in the agency's "brick and mortar" responsibility of getting the bases ready for USAF occupancy, including excavation, pouring of foundations, structural steel work, all tunneling, air conditioning, real property installation, power houses and lines and propellant loading systems.

Contract with L-T-V initially covered only 9,000 items, but effectiveness of the system—which BMCO considers its most reliable report of progress and the best source of information on the construction project—has led to its extension to develop data in even finer detail.

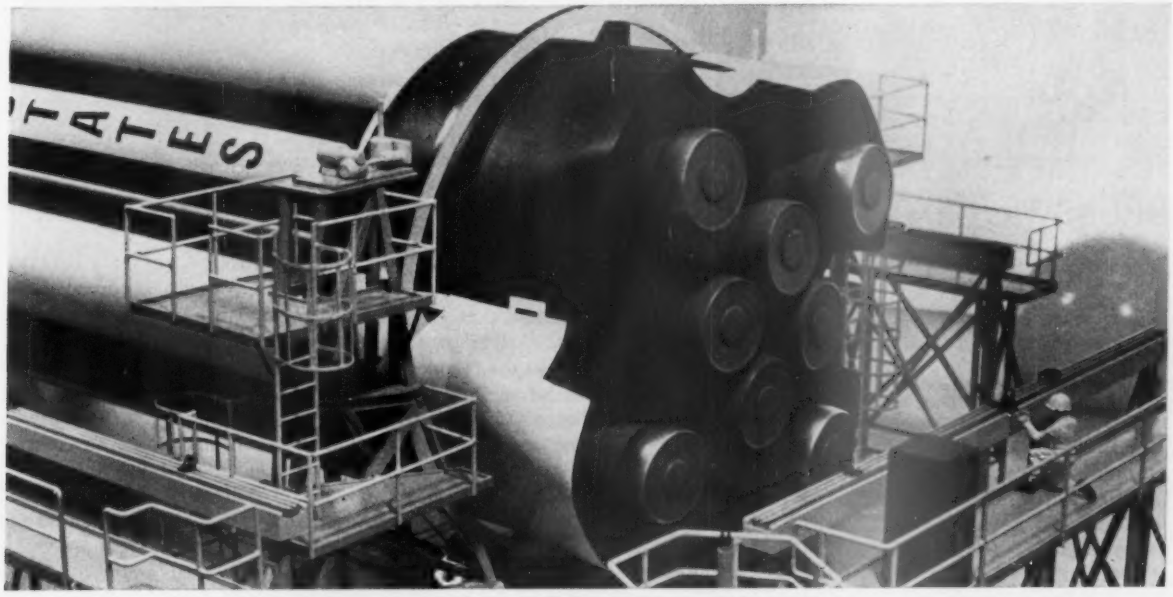
TRACE is an adaptation of a data system used by Temco for some years covering 80,000 items manufactured—keeping track of every step of the process from the time the raw stock or vendor-supplied equipment is contracted to the time that particular piece of work is completed. The company states that the system has been responsible for its never missing an end-item delivery date in the eight years the system has been in operation.

As tailored to Titan I base construction reporting, TRACE provides weekly reports with computations of the completion percentage of each division of work to be accomplished, the status of critical equipment, listings of scheduled increments of work which were not accomplished as scheduled and deliveries of material due during the next reporting period.

Reporting program for the computer is developed by L-T-V manufacturing planners using Corps-supplied work drawings, specifications and schedules for each launch site. Then the sites are broken down into fine detail from complexes to systems, subsystems and all their attendant equipment and work elements are assigned to each step of the installations. This detail is carried down to, for example, the installation of mounts for a generator that supplies power to an air conditioner (considered a subsystem) that is part of a particular propellant loading terminal (considered a system) in a particular launch site. Highlight of the work element system is that these elements are weighted differently depending upon their importance in the installation, utilizing a point system that bears a relationship to time and cost—determined by construction industry standard fair cost data.

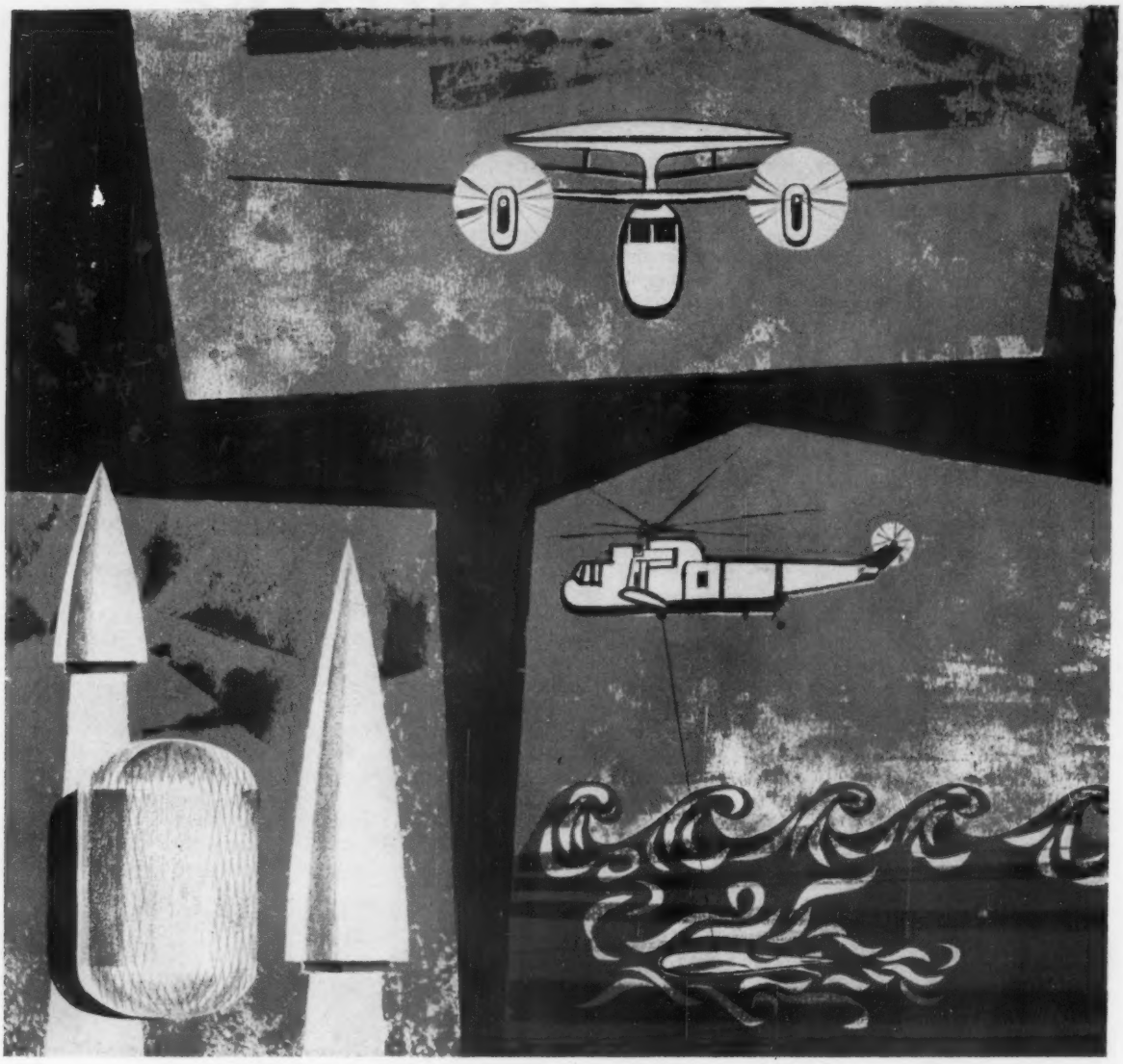
Weighting factor is a crucial part of the program, since it provides the guide to the actual value of work accomplished and that yet to be done. Mere volume of work accomplished cannot cover up for slippage of some critical items that actually would put a site behind schedule, which can be the case in some other reporting methods that had been used. L-T-V TRACE engineers pointed out, for example, that one base had been considered 93% complete, whereas their system showed that the installation was only 70% along the way to completion.

The master deck for computer analysis contains 16,000 cards, each one representing a work element, its scheduled due to start date, scheduled com-



Saturn Booster Alignment, Weighing

Saturn first-stage booster is checked in Brown Engineering Co.'s WAAMAC system (shown in model form at ARS meeting) which determines booster weight, center-of-gravity location and moments of inertia about all three axes. System also optically aligns propellant tanks, engine thrust vectors and various mounting pads with respect to both the aerodynamic and geometric centerlines of the booster. WAAMAC system will be tied to completely automatic checkout equipment. Complete determination of Saturn first-stage characteristics took 1½ days using WAAMAC (Weight, Alignment and Mass Center Determination equipment).



BRUNSWICK EXCELS IN LIGHTWEIGHT/HIGH-STRENGTH STRUCTURES:

In the fulfillment of space-age requirements for maximum strength/weight ratio, electrical transparency and complete reliability, Brunswick is an acknowledged leader.

An increasing number of successful programs have depended upon Brunswick's fiberglass filament winding process. These include radomes for supersonic aircraft such as the F105, F4H, A2F, F106, and the Bomarc "B" missile. Brunswick's filament-wound rocket motor cases are currently being used in the Polaris, NASA, and other classified programs.

In laminated plastic structures, too, Brunswick has won the respect of both military and industrial leaders through the successful fabrication of the big 22-foot rotodome for the Grumman W2F, missile wings, integrated antenna systems, and undersea devices such as "towed fish."

Brunswick's capability has also been demonstrated in metal honeycomb assemblies for jet aircraft, helicopters, reflectors, containers, shelters, and other high-strength/lightweight applications.

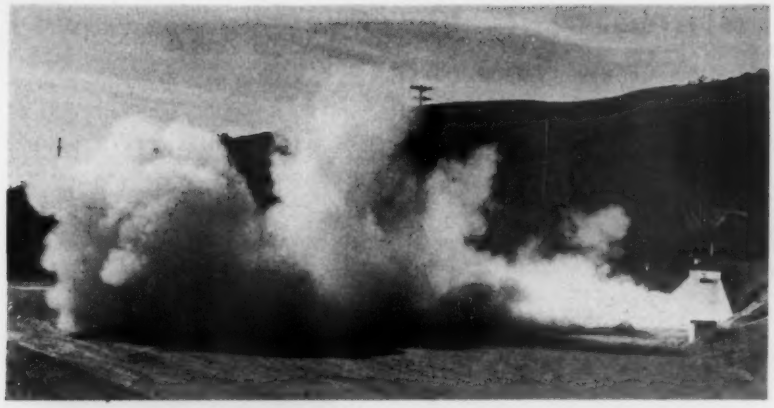
Working from this wealth of experience, creative engineers and scientists at Brunswick await new challenges in still more advanced programs. Can we help you?

Our complete design, fabrication, and test facilities (including electronic test range) are at your disposal. Contact us today for your subcontracted components.

Interested engineers will find it rewarding to discuss career futures with Brunswick, an equal opportunity employer. Write or call Brunswick Corporation, Defense Products Division, 1700 Messler Street, Muskegon, Michigan.

MAKES YOUR IDEAS *WORK*

Brunswick
CORPORATION



Refrigerated Solid Rocket Fired

Frost-covered solid-propellant rocket motor, refrigerated to —50F, has been successfully fired by Grand Central Rocket Co. The propellant was polycarbutane-R. The 14 ft. 36 in. dia. motor contained 6,500 lb. of the propellant. Burning time on the test stand was more than 30 sec. and generated thrust averaged 53,000 lb. Firing, photographed shortly after ignition, took place in Beaumont, Calif.

pletion date and the percentage of work completed at time the card has been processed.

Weekly, 650-700 updated cards are air-mailed to each of the six Titan bases monitored by L-T-V and the company representatives there, working with Corps personnel, physically check the construction progress to report the percentage of work completed at the time of checking. The cards provide the base with information on all work that is past due, plus that which is to be started in the week ahead. Cards are air-mailed back to L-T-V at Dallas, where the new data is key-punched and then is integrated with a master tape. The tape then is used to make a new up-to-date run of the master deck which notes on its cards all items not completed as scheduled, those scheduled to be completed in the next reporting period and all items to be started in work at the next reporting period.

Cards are also revised depending on whether engineering changes are put into effect during base construction. L-T-V TRACE engineers state that the system permits rapid integration of such changes and marks a considerable improvement over previous methods where incorporation of changes often lagged months behind actual time of receipt.

In the course of processing, the computer also has fed point values to the cards on the basis of "weight" of work accomplished according to that reported, putting each measure of work accomplished or behind schedule in its project.

In process is a system of transceivers at each base, where the cards would be punched and stacked on the spot and the data then transmitted to Dallas for punching duplicate cards for IBM processing.

The master tape also is utilized in preparing six reports, for BMCO and base personnel. These vary in detail and complexity, depending upon the user. One is a master copy, covering progress of all 16,000 entries; another covers events failing to occur and those scheduled to occur; another consists of the data developed in graphic stack-chart presentation for the base through the system level, for quick scanning by management personnel; another will provide the same data covering all bases for the same type of personnel; another is a progress report on the status of equipment procurement. Since the propellant loading systems have turned out to be a particularly critical construction problem, another separate report covers just this system.

A valuable side benefit of the data reporting system is its use in making progress payments to contractors, preventing overpayments and in later contract renegotiation by the Corps or contractors. Weekly master tapes are kept for three years. By running the tape through, L-T-V can determine, for example, exactly at what point in a construction process a contractor or subcontractor became involved in engineering changes that may have affected his cost and provide data on the amount of work concerned.

L-T-V believes that the system has applications beyond those already tried —it is trying to interest USAF in using it for that service's missile site activation programs. Also it feels there is a market for the system on other complex construction programs, such as dams, complex building sites and the like. The company notes that the system also is compatible with critical-path management programs such as PERT, Navy's Program Evaluation Review Technique (AW Apr. 10, p. 80).

PUMP PRIMERS

ARTHUR A. NICHOLS

HIGH ALTITUDE PUMPING EFFICIENCY

► Engineers concerned with the pumping of various aviation fluids know well the difficulties of getting good performance at high altitudes where low inlet pressures are encountered. Pumps which work well at low altitudes frequently run into trouble when they encounter the rapid pressure changes, shock and turbulence which promote foaming and lowered efficiency at high altitudes.

► **Gerotor pumps are efficient at high altitudes and therefore are frequently specified for this service. A specialized form of internal gear pump, the Gerotor has an inner toothed element and meshing outer toothed element. The inner Gerotor has one less tooth than the outer and the missing tooth space forms a chamber for transporting the fluid from the inlet to the outlet port.**

FIG. 1

► Slow opening of the chamber as it traverses the large inlet and discharge ports results in avoidance of the sudden shock, rapid pressure change and turbulence which, in other types of pumps, results in foaming and lowered efficiency. Thus, Gerotor pumps offer exceptionally good performance at high altitude.

► **Low relative speed and closely held clearances between the two Gerotor elements mean high mechanical efficiency is maintained.**

► Low weight, high performance and unusual adaptability to space and geometry of housing structure make Gerotor pumps ideal for gearbox lube and scavenge service.

► **Engineers concerned with drives, auxiliary power sources, gear boxes and various transmission design problems involving pressure lubrication have found Gerotor type pumps extremely useful in their attempts to hold weight down and achieve maximum compactness with high service reliability.**

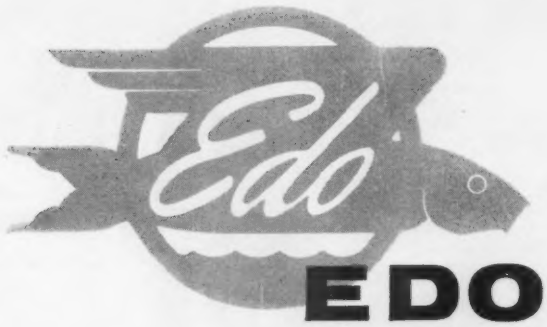
► Applications for Gerotor aircraft pumps lie in the range of pressures up to 1000 psi. They are suitable for low pressure hydraulic and servo systems, hydraulic motors, lube, scavenge and booster service, electronic coolant pumping in aircraft and guided missiles, and similar applications.

► *Technical data is available and your inquiry is invited. Write:*

W. H. NICHOLS CO.

Makers of Zenith Metering Pumps and the Nichols Milling Machine "the miller that uses its head".

48 WOERD AVE., WALTHAM 54, MASS.



EDO

LORAN C NOW

EDO, world leader in the design and manufacture of long range navigation systems*, proudly announces the immediate availability of the new Edo Model 345 A/C Loran . . . complete Loran A and the vastly extended, far faster Loran C coverage in a single system.

Advantages include:

- **Light weight**
- **Low cost**—complete A/C unit is less than half the price of Loran C systems available or in the talking stage.
- **Direct reading console**—panel-mounted unit is simple to operate, permits Loran C fixes 3 times faster than with Loran A.
- **Outstanding performance**—accuracy of pinpoint fixes is limited only by the sharpness of the pencil. Maintenance-free, too.

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USAF Contracts

Following is a list of unclassified contracts for $25,000 and over as released by U.S. Air Force contracting offices:

HEADQUARTERS, ELECTRONIC SYSTEMS DIVISION, AIR FORCE SYSTEMS COMMAND, USAF, LAURENCE G. HANSCOM FIELD, BEDFORD, MASS.

ITT Federal Laboratories, ITT Corp., Nutley, N. J., design, develop and a "clean" breadboard of a light-weight solid state monitor for a TACAN ground station, job (151079), AF19(604)-8459, awarded May 17, 1961, $69,136.

University of Alaska, College, Alaska, the study of arctic propagation, job (RFP 148586), AF19(604)-5574, awarded May 17, 1961, $30,000.

Aeronutronic Division, Ford Motor Co., Newport Beach, Calif., investigation of fundamental study of "cryosar" operation and application, job (RFP 151170), AF19(604)-8458, awarded May 19, 1961, $98,202.

Federal Systems Division, International Business Machines Corp., Kingston, N. Y., research on the rectification of satellite photographs by digital techniques, job (RFP 129196), AF19 (604)-8432, awarded May 16, 1961, $39,400.

Microwave Associates, Inc., Burlington, Mass., study of plasma amplifiers at microwave frequencies, job (RFP 160651), AF19(604)-8372, May 17, 1961, $63,781.

Barnes Engineering Co., Stamford, Conn., wide field radiometers and components, 2 ea., (RFQ 130861), AF19(604)-8728, awarded June 1, 1961, $49,998.

Cornell Aeronautical Laboratory, Buffalo, N. Y., conduct a study for optimization of command and control of tactical offensive forces within 412L environment, job (RFP 99528), AF19(604)-8801, awarded June 1, 1961, $94,580.

Ionics, Inc., Cambridge, Mass., study of the basic problems encountered in ion exchange membrane fuel cells, leading to the development of an efficient fuel cell, job (RFP 129206), AF19(604)-8508, awarded May 31, 1961, $49,381.

General Electric Co., Utica, N. Y., investigation of microwave artificial dielectrics with controllable index of refraction, job (RFP 148165), AF19(604)-8488, awarded May 31, 1961, $43,425.

Materials Research Lab. Division, Tyco, Inc., Waltham, Mass., study of the possibility and feasibility of growing high quality single crystals of intermetallic compounds from a solvent, job (RFP 05797), AF19(604)-8803, awarded May 29, 1961, $49,870.

Consolidated Electrodynamics Corp., Pasadena, Calif., development of a quadruple mass filter for analysis of the atmosphere in the 50 to 90 km. altitude range, job (RFP 123140), AF19(604)-8510, awarded May 30, 1961, $97,114.

Mechanical Division, General Mills, Inc., Minneapolis, Minn., balloon, polyethylene, 1.5 mil, job (RFQ 149415), AF19(604)-8765, awarded May 29, 1961, $57,240.

HEADQUARTERS, AERONAUTICAL SYSTEMS DIVISION, AIR FORCE SYSTEMS COMMAND, USAF, WRIGHT-PATTERSON AIR FORCE BASE, OHIO.

Aero Hydraulics Div., Vickers, Inc., Torrance, Calif., starters, aircraft engine, hydraulic, USAF type STU-9/A27, Aerno 42-8900, (Army installations and spares for YHC-1B FY-61) and related data. Contract AF 33(600)-42946, dated April 10, 1961, 46 ea., $175,580.

Norair Division, Northrop Corp., Hawthorne, Calif., additional facilities under the modernization and replacement program. Supplemental agreement No. 7, dated April 25, 1961, to contract AF 33(600)-41589, $760,979.

Lear, Inc., Grand Rapids, Mich., gyroscopic assembly, displacement, type AF/A24G-1, Aerno 60-6316, FSN 6615-794-0582, Lear model 2171W. (Usage: spares for F-105D aircraft, FY-61) Letter contract AF 33(600)-43046, dated Apr. 24, 1961, 112 ea., $338,400.

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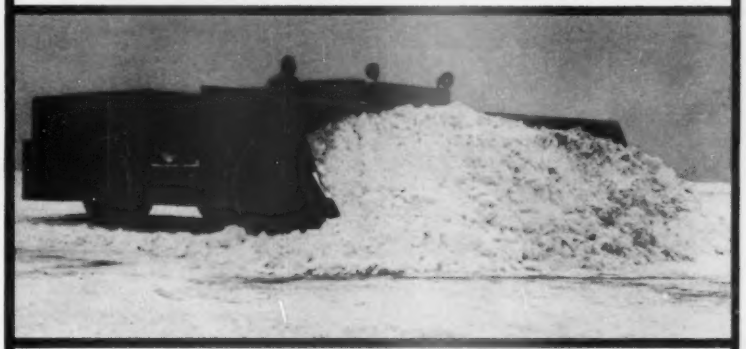

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The SPG-51 reflector went into production—three a month. As an extra fillip, the Special Products group lopped another 25 pounds off weight, without reducing structural integrity. Nobody asked them to, they simply didn't give a damn for tolerance.

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Hughes Aircraft Co., Culver City, Calif., various components of AN/APG-51B and AN/APG-51C radar sets. Letter contract AF 33(600)43071, dated Apr. 20, 1961, $581,180.

Lockheed Aircraft Corp. Marietta, Georgia, IRAN and maintain NC-130B aircraft. Contract AF 33 (600)-4313, dated Apr. 20, 1961, $110,000.

Laboratory of Electronics, Inc., Boston, Mass., acquisition and installation of laboratory and testing equipment. Supplemental agreement No. 2, dated Mar. 10, 1961, to contract AF 33(600)-38000, $158,101.

Lambert Engineering Co., St. Louis, Mo., test sets for POD, aircraft camera ASW, type LB-11A, drawings, microfilm and handbooks. Supplemental agreement No. 3, dated May 19, 1961, to contract AF 33(600)41514, 125 sets, $75,000.

Sperry Phoenix Co. Div., Sperry Rand Corp., Phoenix, Ariz., E-4 autopilot system components, spare parts, aerospace ground equipment and data. (Usage: SC-130B, C-130B and C-130E Acft.) Contract AF 33(600)-42745, dated May 5, 1961, $715,950.

The Magnavox Co., Fort Wayne, Ind., modulator-radio, MD-198/ARC-34 and related data. Contract AF 33(600)-4332, dated May 2, 1961, 283 ea., $38,530.

Lockheed Aircraft Corp., Burbank, Calif., TF-104G aircraft, spare parts, aerospace ground equipment and data. Letter contract AF 33(600)-43459, dated May 26, 1961, $24,762.

Technology, Inc., Dayton, Ohio, structural flight loads recording program for F-106 aircraft. Contract AF 33(600)-43463, dated May 19, 1961, $297,969.

HEADQUARTERS, AIR FORCE FLIGHT TEST CENTER, AIR FORCE SYSTEMS COMMAND, USAF, EDWARDS AFB, CALIF.

Central Research Dept., Air Reduction Co., Murray Hill, N. J., advanced test methods for determining operational characteristics of propellants, $91,900.

Rocketdyne Div. of North American Aviation, Inc., development of a system to identify rocket exhaust products. Contract is for $101,584.

HEADQUARTERS, AIR FORCE MISSILE TEST CENTER, AIR FORCE SYSTEMS COMMAND, UNITED STATES AIR FORCE, PATRICK AFB, FLA.

Arnoux Corp., Los Angeles, Calif., telemetry decontamination systems, PR 61-1096, contract AF 08(606)-4622, June 19, 1961, $202,488.

Sperry Microwave Electronics Co., Division of Sperry Rand Corp., Clearwater, Fla., radar beacon checkout system, PR 61-1022, contract AF 08(606)-4646, June 19, 1961, $106,762.

Milgo Electronic Corp., Miami, Fla., data converters and mod. IV sequencer, PRs 61-1144 and 61-1169, contract AF 08(606)-4648, June 21, 1961, $92,292.

Dynatronics, Inc., Orlando, Fla., range safety officer's console and display systems, 2 ea., PR 61-1001, contract AF 08(606)-4651, June 14, 1961, $568,966.

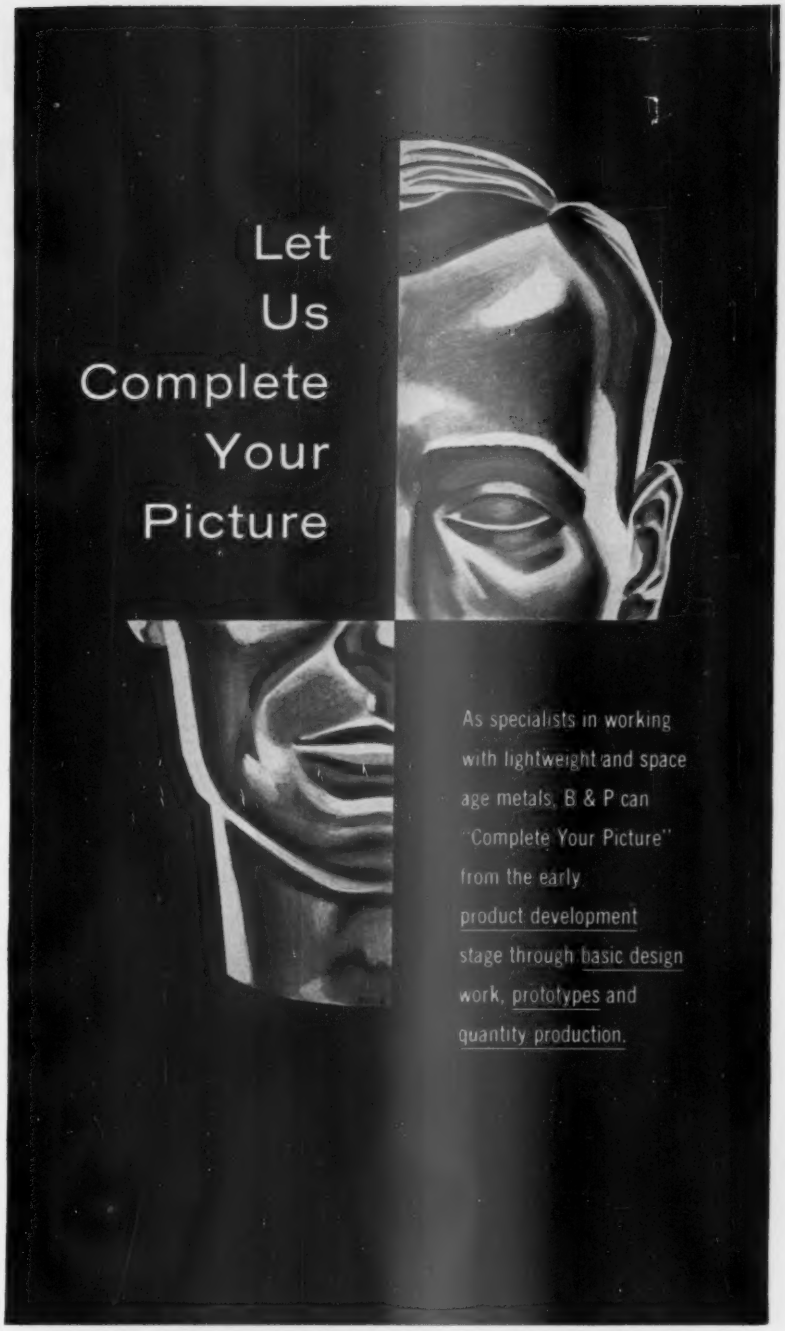
Itek Laboratories, Division of Itek Corp., Cambridge, Mass., frequency standard, 15 ea., PR 61-1125, contract AF 08(606)-4665, June 20, 1961, $114,422.

Dynatronics, Inc., Orlando, Fla., telemetry PCM tape copy system PR 61-1123, contract AF 08(606)-4683, June 15, 1961, $168,397.

DIRECTORATE OF PROCUREMENT AND PRODUCTION, NORTON AIR FORCE BASE, SAN BERNARDINO CALIF.

General Electric Company, Syracuse, N. Y., test equipment (RTS maintenance benches) to support SM-65 (Atlas) organic maintenance plan for FY '60, letter contract AF 04(607)-5784, March 14, 1961, $100,000.

Missile & Space Vehicle Department, General Electric Company, Philadelphia, Pa., initial MGE/OGE spares and depot overhaul spares for SM-65, General Electric Mark IV re-entry vehicle subsystem, Letter contract AF 04(607)-5849,. May 17. 1961, $70,000.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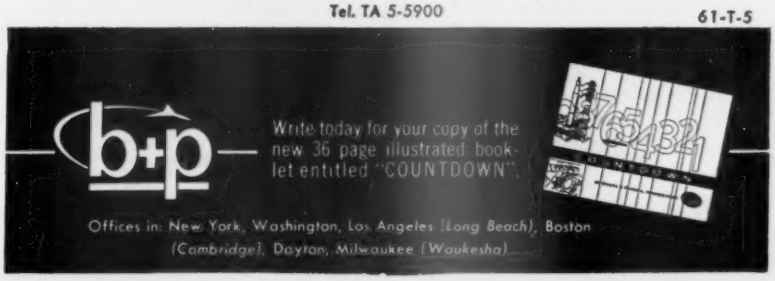
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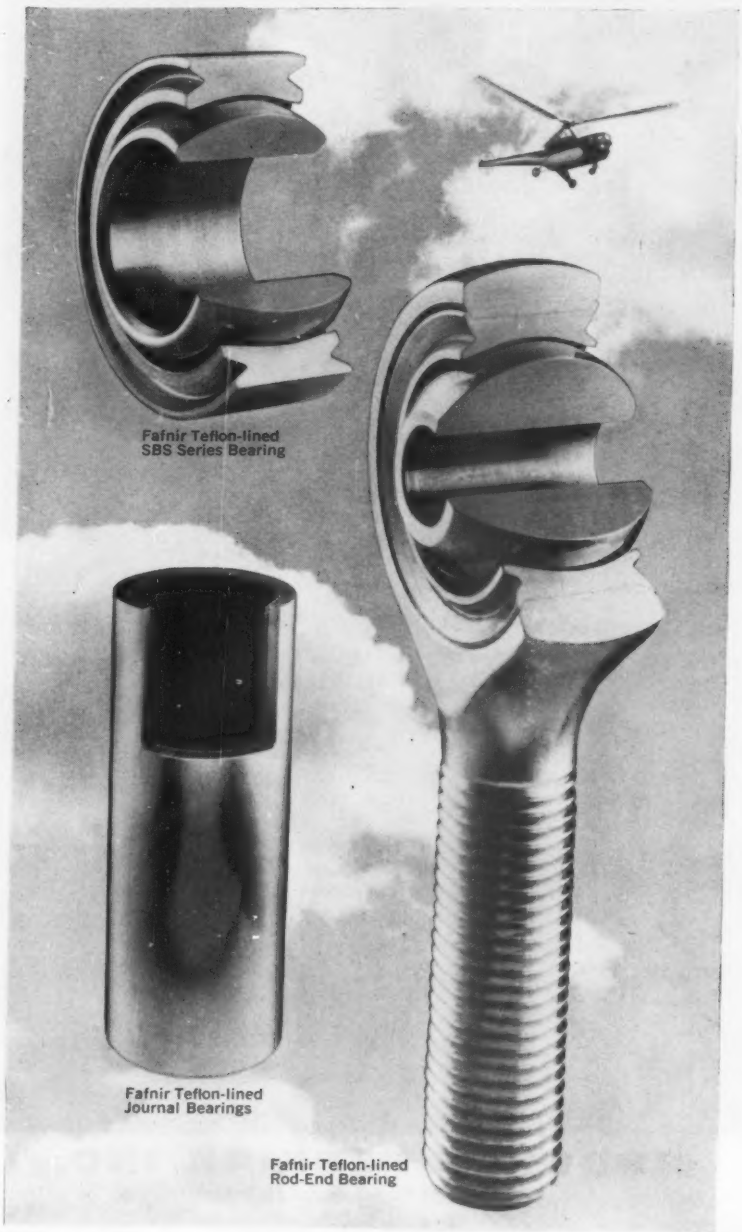

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Fafnir Teflon-lined Bearings are available in spherical, rod end, and journal types. They are self-lubricating and provide low-torque performance under severe loadings. The Teflon liners are shock-resistant and chemically inert.

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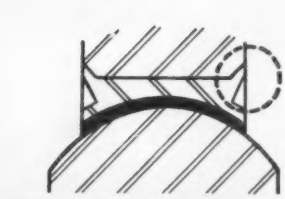
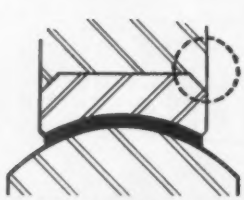


NEW — Fafnir SBS Bearing outer ring swaged over housing chamfer.



CONVENTIONAL — Housing chamfer swaged over Fafnir BS Bearing outer ring.

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British Weigh VTOL Powerplant Designs

By Herbert J. Coleman

London—Division in the British emphasis on VTOL design—powerplants with rotatable nozzles, or pure lift engines combined with a propulsion engine—came into sharp focus at the recent Eighth Anglo-American Aeronautical Conference here.

The protagonists are Bristol Siddeley, makers of the BS.53 Pegasus, the single powerplant with nozzles rotating 100 deg., and Rolls-Royce, developers of the RB.108 and RB.162 pure lift engines, acting in combination with a propulsion engine, or rotatable in themselves.

Both designs have flight time. Rolls-Royce has considerable experience with its RB.108 engine in the Short SC.1, and Bristol Siddeley is getting its initial flight experience in the Hawker Siddeley P.1127 strike fighter (AW cover, Sept. 4).

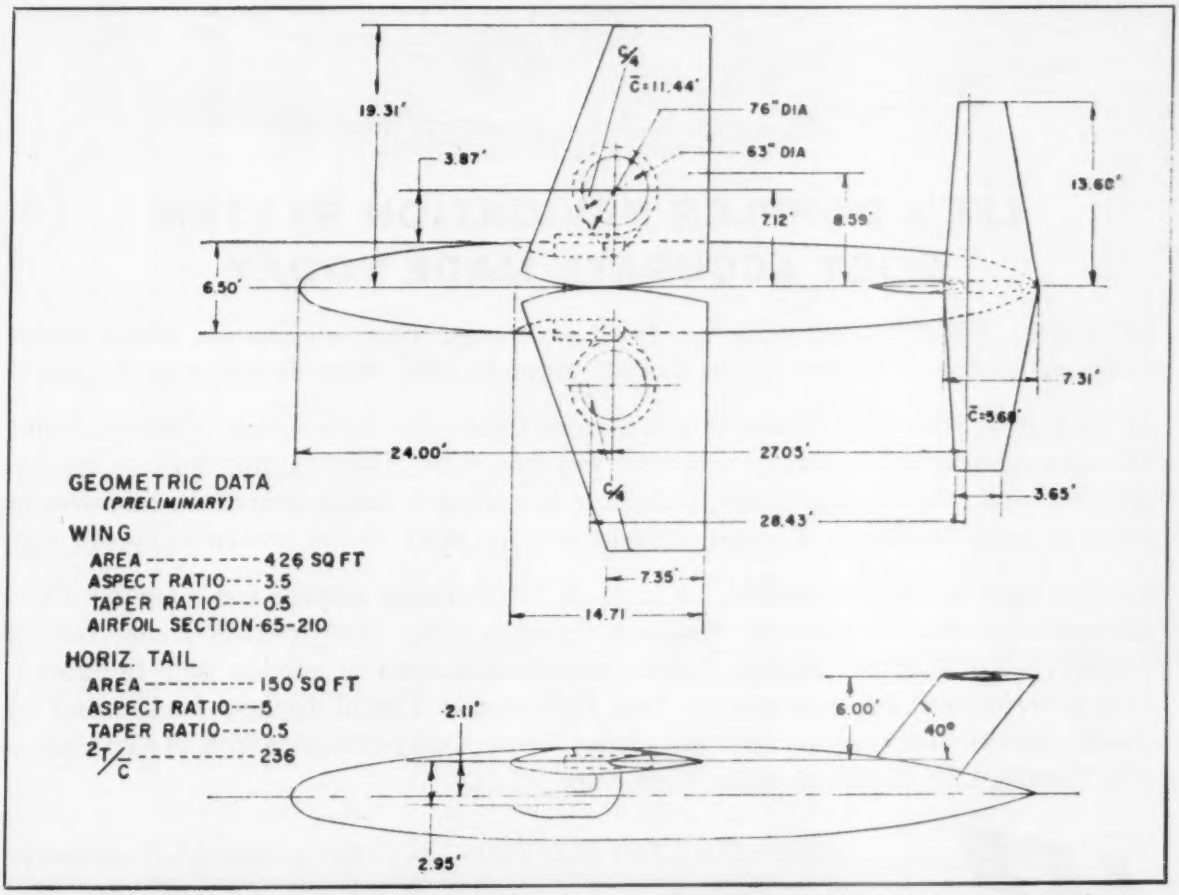
But despite its confidence in the nozzle type of thrust deflection, Bristol Siddeley is hedging its bets by developing a pure lift engine, primarily for the Royal Air Force tactical transport replacement competition (AW Sept. 18, p. 43). It would be used to give 100% VTOL capability to an airplane fitted with four Pegasus engines.

In support of the deflected thrust system, Dr. S. G. Hooker, head of the Bristol Siddeley design team which came up with the Pegasus, said he could see no point in "giving machinery a free ride around the countryside," in referring to pure lift engines cut off after takeoff and propulsion engines taking over.

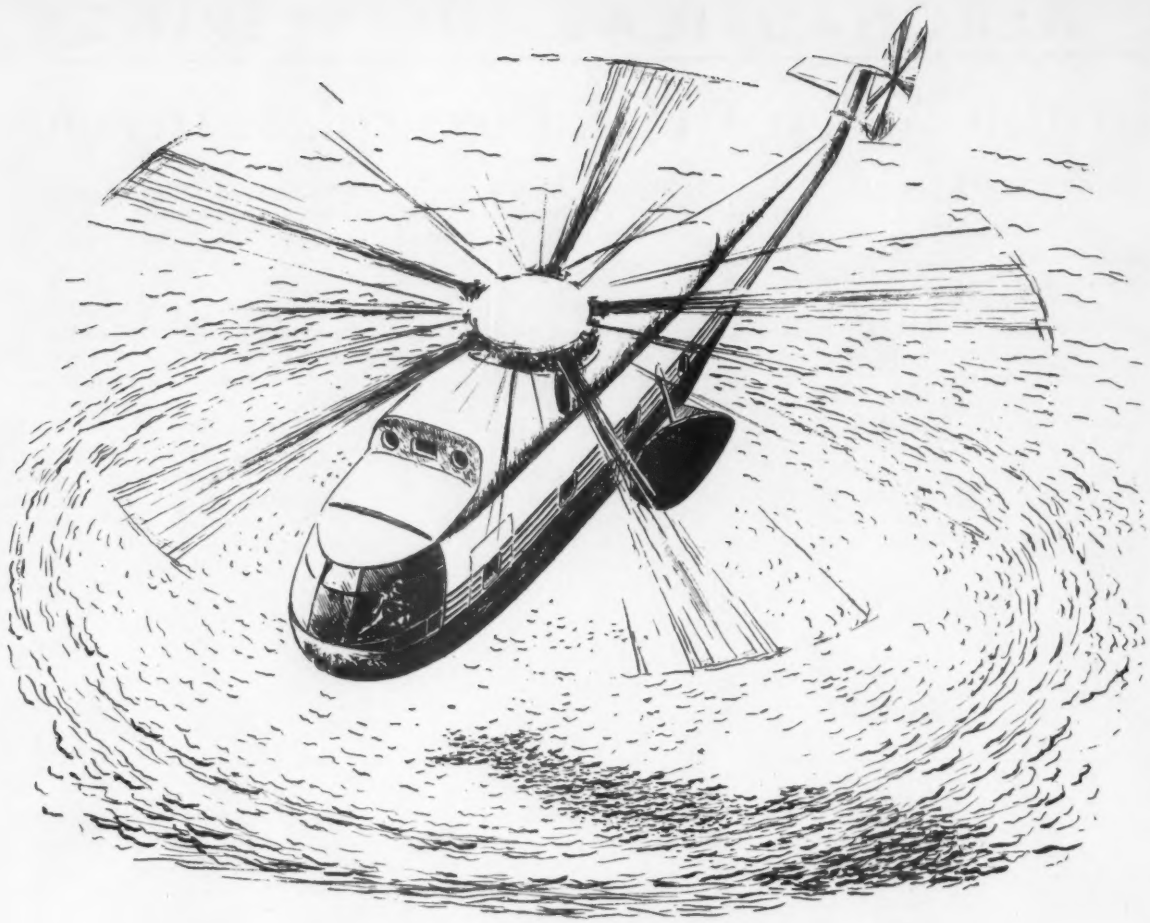
On the other hand, H. Pearson, chief engineer (performance and research) for Rolls-Royce, contended that if designers are aiming at STOL characteristics, they may as well make the airplane completely VTOL. Referring to thrust deflection devices, Pearson claimed that deflector weight was such that designers should consider adding more lightweight lifting power. Rolls investigations, Pearson added, show little penalty in pure lift, as against deflecting the thrust, noting that deflection also determines the engine position, i.e., moving it aft adds a larger moment.

One U. S. delegate, Norman E. Nelson, Doak Aircraft Co.'s chief engineer on the Doak VS-4DA, backed the tilt-fan design as proven after 250 hr. of flight testing for the U. S. Army. Nelson said the VS-4DA could make a 6 sec. transition (11 sec. normally) and had flown at 200 mph. at 25,000 ft. Nelson added that the VS-4DA "has even flown backward."

Discussing helicopters, George S. Schairer, vice president, research and development of the Boeing Co. said the machine "appears to have no serious competition in those applications



VIEW OF FULL SCALE fan-in-wing test model for use in National Aeronautics and Space Administration's Ames wind tunnel.



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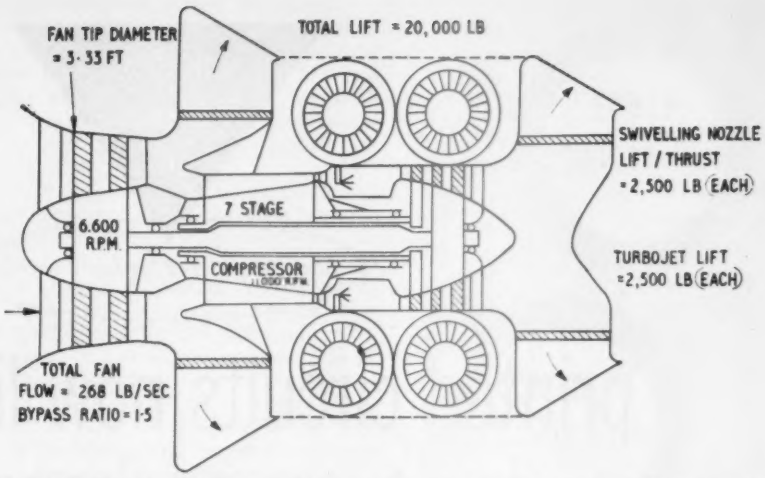
where silence is required or where long hovering is required." In addition, he said, the helicopter "is likely to remain supreme" where distances flown are short and speed is unimportant.

He forecast that helicopters will be built with speed capabilities of above 200 kt., with drag cleanups and proper airfoil choices, and by use of boundary layer control. With these improvements, the helicopter range can be increased by as much as 30%.

Schairer said the compound helicopter is a "compromise type" which pays a large empty weight penalty for a modest improvement in range and speed. He claimed that the compound type will be "little better than the conventional helicopter" unless the rotor can be both unloaded and slowed down.



POSSIBLE LAYOUT for lift/propulsion engine system, as seen by Hawker Siddeley, would produce a total lift thrust of 20,000 lb. Each lift engine would produce 2,500 lb. thrust.

Tilt-Wing Field

In the tilt-wing field, Schairer said all current tilt-wing and tilt-propeller types "suffer from great complexity of the mechanical systems," a necessity to follow the fail-safe concept. Unless the fail-safe problem is solved, he contended, the tilt-wing theory will be limited to special usage.

Schairer called for further investigation of blown flap techniques in the short takeoff and landing design effort, terming this "urgently needed" to clarify their characteristics. He also noted that development of wind tunnel testing procedures for V/STOL aircraft is in its infancy and considerable attention should be given to these techniques, since stalling is a major design consideration and "likely to be the central theme of the aerodynamic design."

Comprehensive tests of the lift fan principle will be accelerated in the near future upon completion of a full-scale fan-in-wing model being constructed for NASA's Ames wind tunnel, according to David Cochrane, general manager of General Electric's Flight Propulsion Laboratory.

Initial testing will center on two fans, engines and diverter valves.

Recent testing has involved a fan with a design lift of 7,430 lb., when operated with a J85 turbojet engine of 2,500 lb. thrust. Some conclusions, Cochrane said, are:

- **Fan inlet**, first judged to be very difficult aerodynamically, has given excellent performance. After 90 hr. of operation, the first fan is still in good condition.
- **Diverter valve** for the J85 engine, built under Air Force contract, has demonstrated good life and reliability.
- **Tunnel tests** show that airplane pitchup moment in transition is controllable by a moderately sized tail, plus hover reaction controls.
- **Performance** has indicated that little difficulty should be encountered in adapting conventional aircraft configurations to VTOL use with lift fans installed in wing or fuselage.
- **Exit louvers** provide ample thrust to drive the airplane forward well in excess of stall speed, so that adequate transition speed margin is available.
- **Lift droop**, or "decay of lift" as the airplane moves forward, has not been a problem.
- **Fan can be started** without serious stress problems when the aircraft is flying at transition speed preparatory to landing. Cochrane said the airplane can then be decelerated promptly by vectoring the louvers.

Problems of control of V/STOL vehicles, presented by P. L. Sutcliffe, chief technician, Hawker Siddeley Advanced Projects Group, in collaboration with V. K. Merrick, of Hawker Siddeley, and A. R. Howell, National Gas Turbine Establishment, centered on reaction controls using the propulsive system, either directly, or with augmentation devices, such as a fan.

Sutcliffe mentioned recent Hawker Siddeley studies on a VTOL high wing aircraft fitted with lightweight lift engines. This airplane probably is an Armstrong Whitworth 650 or 660 used in tests aimed at the Royal Air Force tactical transport competition.

In these tests, control in pitch at low speeds is provided by the elevators and by differential throttling of the lift engines. Control in roll is by ailerons and differential throttling, and control in yaw by the rudder and fore and aft inclination of the lift engine nozzles.

Critical case for pitch control, Sutcliffe said, is in the nose-up sense during an acceleration and the thrust required from each engine is equivalent to about 8% of the takeoff thrust rating. In combining the three control regimes, the simplest method is in assuming that for pitch, all engines ahead of the center of gravity are throttled up an equal amount and those behind the center of gravity throttled down by the same amount.

Similarly, for roll all engines on one wing are throttled up and those on the other wing throttled down. Sutcliffe explained that in this way, the critical bank of engines must have the capability of providing 11% of the takeoff rating, plus another 1% for yaw control, or a total of 12%.

Sutcliffe credited J. Fletcher, chief aerodynamicist for Short Brothers & Harland, for another system of combining control thrust to reduce the net penalty. Fletcher's method involves transferring the roll demand from the most heavily loaded bank of engines to the other axisymmetric bank, readjusting the ratings of the other banks to suit. Maximum increment in thrust for control requirements thus is equal to the maximum single demand; in this case, 8% is required for pitch control, plus the 1% for yaw, or a total of 9%.

Blind Landing Study

Short Brothers & Harland is investigating blind landing techniques, in a joint study with the Royal Aircraft Establishment at Bedford, using the second prototype Short SC.1 VTOL research plane. Major part of this program, according to J. J. Foody, head of Short's analytical department, is development of instrumentation aimed at the VTOL regime and its particular problems. The instrumentations, Foody said, must give adequate direction, leaving the pilot to act as the servo; possible solution is a director horizon, developed by Sperry for helicopters, in which a horizontal bar is the attitude director and a vertical bar is the bank director. Side and bottom directors are for lift throttle and heading.

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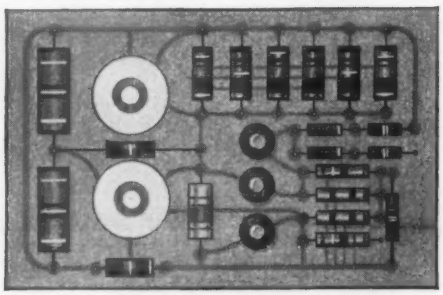

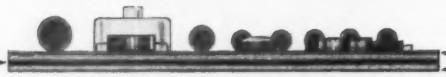

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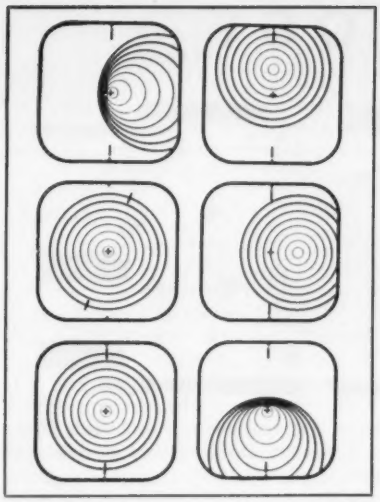

CATHODE RAY presentation for VTOL blind landing puts aircraft at apex of a cone. System will be tested on Short SC.1.

tion, in which the aircraft is envisaged as coming down a cone, the apex of which is positioned beyond the landing point. Foody said this method makes possible a representation of displacement from the correct track, plus a degree of realism he described as "encouraging."

Vertical takeoff and land problem still demanding exhaustive research is that of ground erosion due to thrust blast, according to John P. Campbell, head of the NASA dynamic stability branch, Langley Research Center.

Erosion Resistance

Interesting result of the NASA tests using the Curtiss-Wright X-100 tilt-propeller VTOL aircraft was that when a surface is wet, resistance to erosion is usually greatly increased. Sand, or loose dirt, soaked with water could withstand surface dynamic pressures of up to 20-30 psf. On tests on a sandy beach, Campbell said, maximum dynamic pressure obtained with the X-100, about 25 psf., was not great enough to disturb wet sand.

Tests with dry gravel of varied size showed that dynamic pressure needed to start erosion increases as the size of the particle increases; thus, erosion with this type of surface can be predicted, at least approximately. A good sod surface also could withstand dynamic pressures up to 2,000 psf., although further tests show that sod erosion depends to a great extent on type of soil and vegetation.

Campbell said that for repeated takeoff and landing operations from a given spot, VTOL aircraft will require some form of site preparation, such as metal plates or special types of concrete. Asphalt is not satisfactory because it not only is subject to blast erosion, but melts and releases stones, and the stones may be thrown against the aircraft.

Recirculation of debris is another serious problem, even for helicopters with their low slipstream velocities. In hovering over dry sand or loose dirt, helicopter pilots usually are flying in a dust storm of their own making, Campbell continued.

Tendency to blow debris up around the aircraft is aggravated when there are two or more slipstreams spaced some distance apart, instead of a single slipstream as in most helicopters. With two or more, there is a strong upward flow against the bottom of the aircraft, with greater danger that the machine will be damaged by rocks.

Campbell suggested some form of deflector, either on the aircraft itself or on the landing area, to prevent damage to the airframe or propulsion system. Or, he added, the slipstream could be directed slightly rearward to make STOL runs whenever possible, blowing dust and debris backward away from the aircraft.

PRODUCTION BRIEFING

Royal Canadian Air Force has ordered four additional Boeing Vertol 107 helicopters, bringing to six the number of aircraft purchased. The helicopters, designated CH-113s, will be used for rescue and general utility work.

Army has authorized a transmission overhaul life of 1,000 hr. for the Boeing Vertol H-21C. Previously, overhauls were required every 750 hr.

Hughes Aircraft Co. has received a $58,500 contract from the National Aeronautics and Space Administration's Marshall Space Flight Center to develop a sealant for use with super cold liquid propellants. A rubbery, elastic sealant which will be effective in both launch and deep space environments is planned.

Telecomputing Corp.'s Power Sources Division will develop and manufacture an automatically activated primary battery to furnish in-flight electrical power for the Polaris A3 guidance system under a contract of undisclosed amount from Lockheed Missiles and Space Co.

Solar Aircraft Co. will develop and test frontal sections for aerospace vehicles under a 21-month contract from USAF Systems Command's Aeronautical Systems Division. Lockheed Missiles and Space Co. will perform trajectory and structural analysis. Contract calls for components to withstand 4,500F to 5,500F up to 10 min., with total re-entry times up to 60 min., and a re-entry velocity of 35,000 fps.

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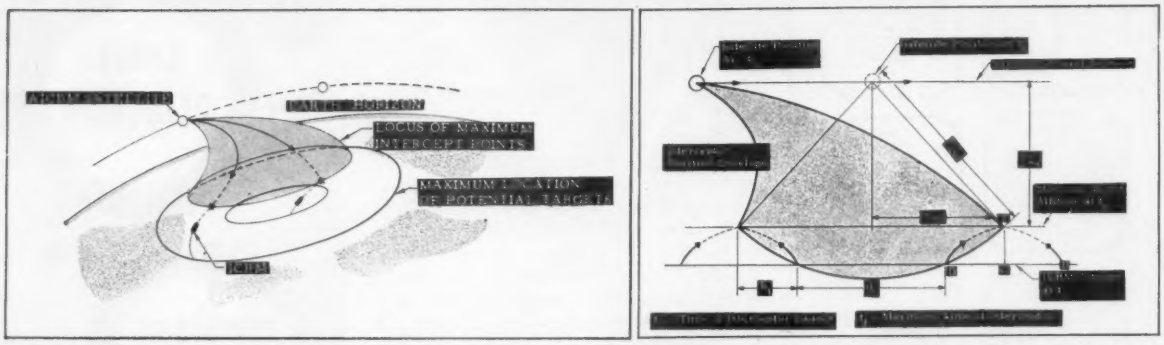


BAMBI CONCEPT of defense against ICBMs would use satellites armed with interceptor missiles that would be fired at ballistic missile boosters during launch phase. Analysis of satellite-based defense system by North American Autonetics Division shows funnel-shaped envelope (right) within which boosters can be intercepted by missiles fired from the satellite.

Bambi ICBM Defense Concept Analyzed

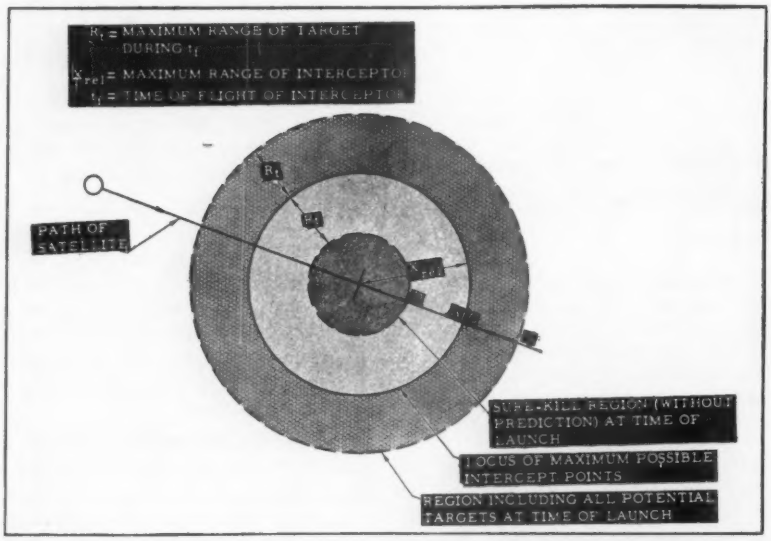
By Philip J. Klass

New York—Satellite-based ICBM defense system, similar to Project Bambi (ballistic missile booster interceptor) would require between 800 and 3,600 satellites in low-altitude orbit to provide full global coverage, according to an analysis presented here during the recent American Rocket Society Space Flight Report to the Nation.

The feasibility of a satellite-based ICBM defense system currently is under study by Convair, Hughes Aircraft and Space Technology Laboratories under sponsorship of Defense Department's Advanced Research Projects Agency as part of the Project Defender program (AW June 19, p. 33).

The report, entitled "Some Optimizations on a Satellite-based AICBM Interceptor," was written by Rudy R. Mueller of North American's Autonetics Division, whose company was an unsuccessful bidder in the Bambi program.

The weight of satellites and interceptors which must be put into orbit for a Bambi type system can be slashed by a factor of 100:1 through the use of computers aboard the satellite launcher to discriminate between ICBM booster targets which can be successfully intercepted and those which cannot, and through the use of interceptor missiles powered by extremely high initial impulse rocket engines, Mueller's analysis indicates.


R_t = MAXIMUM RANGE OF TARGET DURING t_f
R_{rel} = MAXIMUM RANGE OF INTERCEPTOR
t_f = TIME OF FLIGHT OF INTERCEPTOR
PATH OF SATELLITE
R_t
R_i
R_{rel}
SURE-KILL REGION (WITHOUT PREDICTION) AT TIME OF LAUNCH
LOCUS OF MAXIMUM POSSIBLE INTERCEPT POINTS
REGION INCLUDING ALL POTENTIAL TARGETS AT TIME OF LAUNCH

SATELLITE COVERAGE domains are shown to illustrate advantage of using computer aboard satellite to predict which ICBMs will come within range of its missiles. All ICBMs which may be interceptable from a satellite will come from launch pads that lie within largest circle, but only those whose trajectory brings them within the area contained by the middle circle can be intercepted. Unless satellite has computer to predict each ICBM trajectory, the only ICBMs which are certain to be within interception range are those whose launch pads lie within smallest circle.

The Bambi ICBM defense system concept seeks to intercept the ballistic missile during its boost phase, when the booster itself is easily detected by its intense infrared radiation and when it is a comparative "sitting duck." An additional advantage to interception during boost is that there is little opportunity to employ decoys as during warhead re-entry (AW Apr. 3, p. 33).

Inherent in the Bambi anti-ICBM concept is the requirement that the satellite launch platforms must be within several hundred miles of enemy ballistic missile launch sites. This raises the important question of whether the Soviet Union, or the U. S., would long tolerate the presence of armed anti-ICBM satellites over its territory, even if the interceptor missiles carried non-nuclear warheads.

The U. S. already is developing techniques for intercepting and inspecting unknown satellites, and the USSR may be assumed to be doing likewise.

The large number, probably several thousand, of anti-ICBM satellites required to provide necessary coverage, coupled with natural attrition due to the required low altitude orbits and loss due to enemy interception, has raised questions about the economic feasibility of the Bambi approach (AW June 26, p. 29).

However, in Mueller's analysis he limits the study to the physical parameters of the Bambi type anti-ICBM prob-

lem without attempting to assess the over-all feasibility of the basic concept.

The requirement that the anti-ICBM satellite detect the target and launch its infrared-guided interceptor missile(s) in time to intercept the target before the end of its boost period "is a severe restraint and requires high accelerations and velocities for the interceptor," Mueller said.

For the Autonetics analysis Mueller assumes a solid-propellant Minuteman as a representative target because its total boost period lasts for only three minutes. Allowing up to one minute after launch for detection by the anti-ICBM satellite, provides a maximum time of flight to interception of 120 sec. for the interceptor missile. This corresponds to an interceptor missile range of up to 600 mi., depending upon the type used.

Importance of Prediction

The value of using computers aboard the anti-ICBM satellite to sort out interceptable targets from those whose flight path will take them out of range of one satellite's interceptor missile is illustrated in the accompanying sketch (p. 82) showing coverage domains (three concentric circles).

The outer circle contains the earth-based launch points of all ballistic missiles which conceivably might come within range of the satellite's interceptor missiles. The middle circle defines the maximum range of the satellite interceptors. Thus any ballistic missile whose launch pad is within the outer circle and whose trajectory takes it into the area enclosed by the middle circle is a target which can be intercepted. Any ICBM whose launch pad is within the outer circle but whose trajectory is such that it does not move into the area enclosed by the middle circle cannot be intercepted by the anti-ICBM satellite, although it would be a suitable target for an adjoining anti-ICBM satellite.

Similarly, any ICBM whose launch pad is within the middle circle is a potential target only if its trajectory is such that it remains within this area for approximately one minute. If it moves outside the area of the middle circle, it cannot be intercepted by the satellite shown, although it will then become a target for an adjoining satellite.

Only those ballistic missiles whose launch sites lie within the innermost circle are certain to remain within intercept radius of the satellite's interceptors regardless of trajectories which cannot take them outside of the area enclosed by the middle circle before the interceptor arrives.

This means that an anti-ICBM satellite which does not employ a computer to track its targets and predict their future position either must limit its area of effective coverage to the innermost circle, or else must carry and fire many more interceptor missiles, many of which can never hope to intercept their targets in time. If the system is designed to the former criteria, where each satellite's area of responsibility is limited to the innermost circle, considerably more satellites will be required to blanket a given area.

Example Cited

For example, in figures cited by Mueller for several possible optimized systems, to achieve global coverage without prediction would require 3,620 satellites compared with only 2,290 where prediction is used, assuming interceptors use continuous burning rocket engines.

For high initial impulse interceptors, 970 would be required for global coverage without prediction compared with 810 with prediction.

However, this requires considerably more complex equipment aboard the satellite which increases the likelihood of failure, which in turn might require the use of more satellites for redundancy.

(Mueller does not attempt to factor redundancy and individual satellite reliability into his analysis.)

Target Distribution

In determining optimized systems characteristics, the Autonetics analysis assumes that small numbers of ICBMs will be grouped together in "clumps," where the spacing between individual launch pads is a few miles, while the distance between clumps of missiles will be large compared with the radius of action of a single anti-ICBM satellite, that is ranging from perhaps 500 to 1,000 mi.

This is the type of launch pad location arrangement being used by the U. S. in order to minimize the number of missiles that might be knocked out by a surprise ICBM attack, while minimizing the problems of missile control and maintenance.

"Consideration of the economics of the ICBM versus AICBM 'game' (using 'game theory') will show that from the opponent's viewpoint this type of distribution strategy is precisely what he would use in order to maximize the cost of the AICBM system for a given number of available target vehicles," Mueller says.

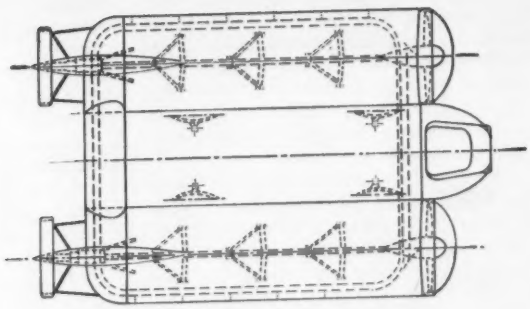
In the Autonetics analysis, Mueller assumed that each satellite has a hexagonal area of responsibility (sketch, p. 87) providing small areas of overlap

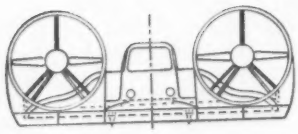
CONCEPT / DATA		Relative Range	Maximum Absolute Range	Characteristic Velocity	Average Acceleration	Interceptor Weight	Diameter of Coverage	Number of Satellites	Orbital Weight of System
Acceleration	Prediction	r_{rel} (naut mi)	$(r_{abs})_{max}$ (naut mi)	V_{ch} (ft/sec)	(g's)	$\frac{W_o}{W_{pay}}$	d_c (naut mi)	N	$\frac{W_{sys}}{pW_{pay}}$
Constant	None	453	951	50,900	13.1	294	344	3620	1,280,000
Constant	Perfect	270	768	30,400	7.86	32.3	427	2290	88,800
Impulsive	None	600	1098	33,800	N/A	46.5	658	970	54,000
Impulsive	Perfect	395	893	22,200	N/A	13.2	718	810	12,800

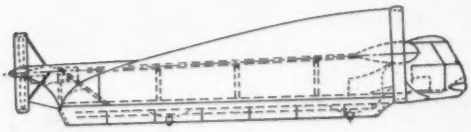
Conditions:

1. Clumped targets, widely spaced
2. Maximum relative altitude travel, h = 165 naut mi
3. Guidance efficiency, $\nu = 0.90$
4. Propellant average specific impulse = 330 lb-sec/sec
5. Interceptor deficiency factor of interceptor, $\eta = 0.15$
6. Interceptor time of flight, t_f = 120 secs
7. Target horizontal travel during t_f, R_t = 250 naut mi
8. Interceptor finite stages factor, $\Omega = 0.20$
9. Satellite weight factor, $\delta = 0.25$

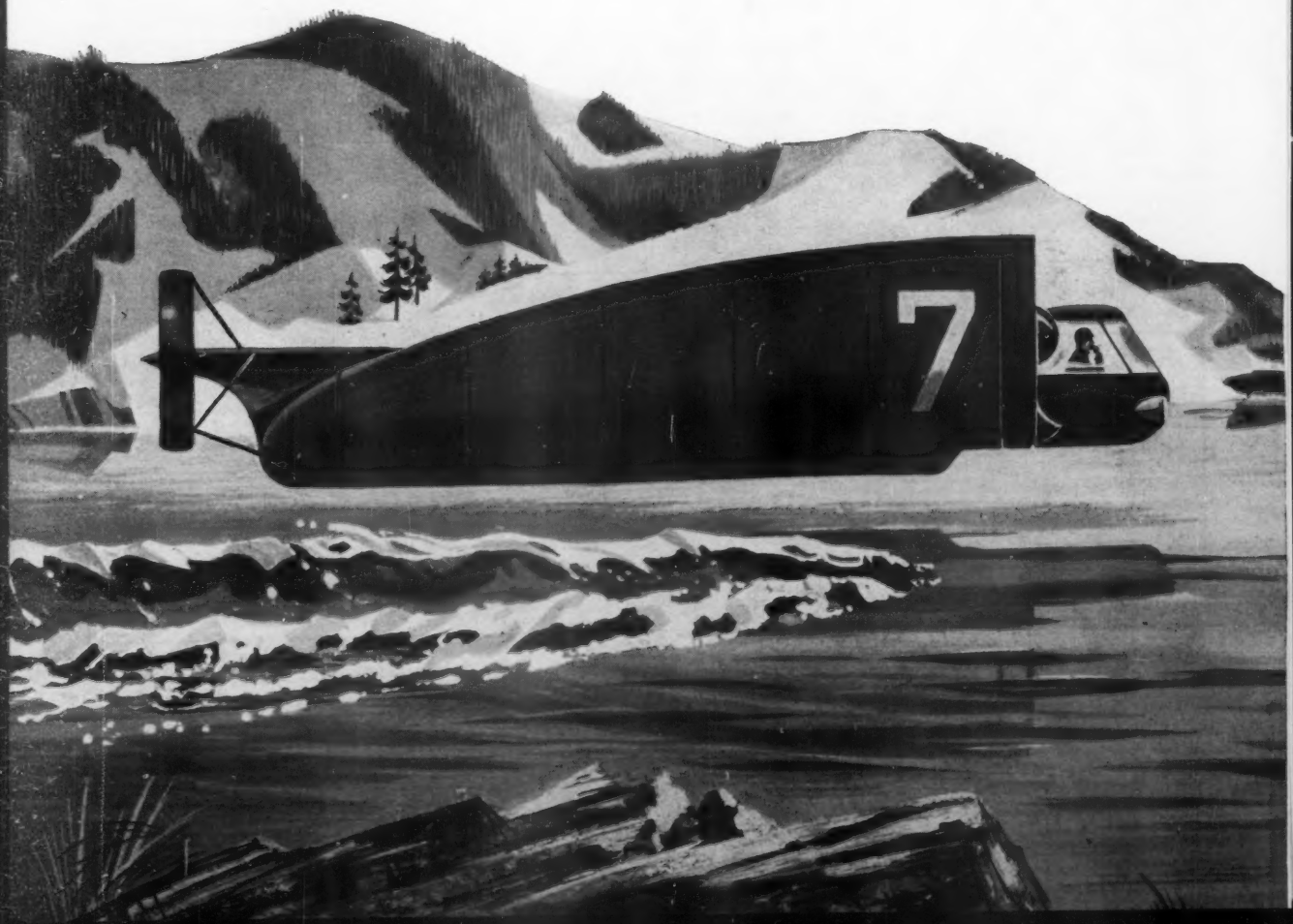
TABLE COMPARES SEVERAL OPTIMIZED Bambi-type ICBM system configurations, showing number of satellites needed for each system and various other bases of comparison. Note variation in the orbital weight of the different systems.







dependable transportation…come hill



or high water

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Although planned for different payloads and missions, both are highly maneuverable, simple to operate and easily and quickly serviced. They are intended to be specific answers to the problems posed by the limitations of conventional transportation.

The smaller of the two Aeronutronic-designed vehicles will weigh 8,000 pounds, carry a 2½ ton payload, cruise at 40 mph. It will have a range of 100 miles and a grade capability of 30%.

The big machine is a high-speed, heavy duty carrier. Weight: a hefty 44,500 pounds, payload: 22,000 pounds, speed: a fast 80 mph, range: 300 miles. It, too, will have a grade capability of 30%.

In spite of this evidence of accomplishment, Aeronutronic's work in the field has just begun. Army Transportation Corps and Navy contracts are speeding further studies into the potentialities of the new vehicle. The ACV is destined to play a significant role in future military and civilian transportation.

Further information regarding the air cushion vehicle, as well as other exciting projects in work at Newport Beach, may be had by writing to Aeronutronic.

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between adjacent satellites.

To illustrate the use of non-dimensional parameters developed in the Autonetics analysis and to give an indication of typical numbers, Mueller applied the parameters to four different situations:

- **No prediction and constant** acceleration of interceptor missiles.
- **Perfect prediction and constant** acceleration of interceptor missiles.
- **No prediction and high-impulse** initial launch of interceptor missiles.
- **Perfect prediction and high-impulse** initial launch of interceptor missiles.

Prediction Results

The results, shown in the accompanying table, indicate that a satellite that does not employ prediction and uses constant acceleration interceptors would provide an area of coverage having a diameter of 344 naut. mi., thereby requiring a total of 3,620 for global coverage. With the addition of perfect prediction, the diameter of the area of coverage of a single satellite would increase to 427 naut. mi., cutting the total number required to 2,290.

Using high initial impulse propulsion for the interceptor would increase the diameter of the satellite's area of coverage to 658 naut. mi., and reduce the total number required for global coverage to 970. With both perfect prediction and high-impulse propulsion, the diameter of the coverage area would increase to 718 naut. mi. and the total number required then would be cut to 810.

A gross measure of the total weight of hardware that would have to be put in orbit for these four different system approaches can be obtained from the calculated ratio of total weight of satellites and their interceptors to the weight of the interceptors (payload) alone.

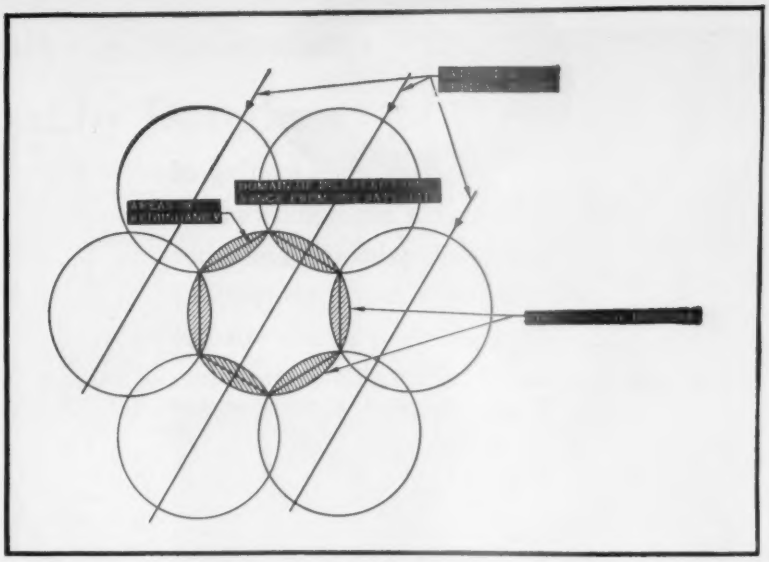
For the worst case, using constant thrust propulsion and no prediction, the figure is 100 times larger than the system weight ratio for a system using satellites with prediction and impulsive propulsion, Mueller's analysis indicates.

Depending upon the design approach selected, the optimum effective interceptor relative range varies from 270 to 600 naut. mi.

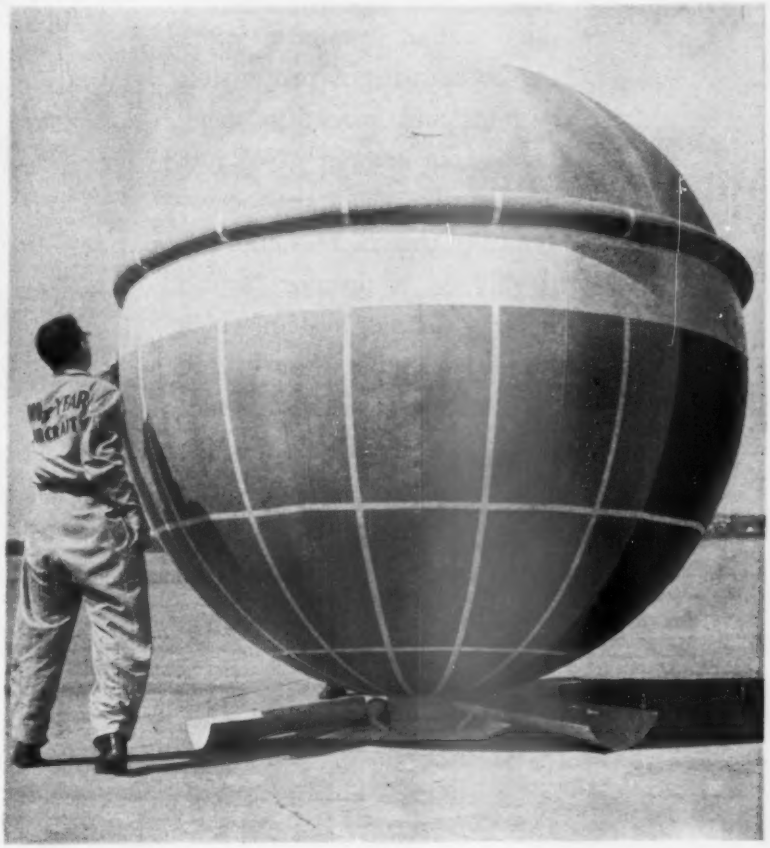
Some Factors Excluded

Mueller cautions that his analysis does not include some factors, such as the maximum detection range of satellite infrared detectors and the interceptor infrared homing device.

Despite these limitations, Mueller concludes that there appears to be an "overwhelming" advantage, in terms of total system weight in orbit, to the use of target prediction aboard the satellite and impulsive acceleration of its interceptor missiles.



SPACING between adjacent satellites will depend upon their effective range of action. Some overlap in coverage would exist as shown in sketch above.



Re-entry Drag Balloon Developed

"Ballute," coated fabric drag balloon capable of inflating in $\frac{1}{10}$ sec. to control the high-speed deceleration of manned and unmanned re-entry vehicles, has been developed by Goodyear Aircraft Corp. Once the 9-ft.-dia. balloon has helped ease the re-entry vehicle through the heat barrier encountered on entering the upper atmosphere, a parachute would be deployed to complete the recovery. The high-altitude recovery system was developed for the Air Force Systems Command's Aeronautical Systems Division.

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Government-Industry Relationship Re-evaluation Asked by Douglas

Overhaul of the military procurement legislation of 1947 and the jungle of extensions and interpretations that has grown up around it has been suggested by Donald W. Douglas, Jr., president of Douglas Aircraft Co. in a speech at the Western Briefing Conference on Government Contracts at Monterey, Calif.

Douglas also suggested a fundamental re-evaluation of the philosophy under which the government does business with defense industry. He said that the government-industry relationship set up in 1947 has been made obsolete by advances in military technology and new technical philosophies.

Douglas called for the abolition of the statutory requirement for advertised bids. The complexity of modern military equipment, the advent of weapon system contracting and the need for new and elaborate research, test and manufacturing facilities often makes the number of well-qualified companies very small.

"In these circumstances, the statutory requirement for advertised bids is both unrealistic and antiquated and does not serve the best interests of the government itself. The near impossibility of accurately predicting costs or the final form the weapon system will take makes negotiation with qualified companies the only practical path to follow," he said.

Negotiated Contracts

He pointed out that the Defense Department has, in fact, been tending toward more negotiated contracts but only as a series of exceptions rather than by more appropriate and efficient new procurement legislation. "The laws governing procurement enacted, supplemented, and amended over the years are a legal jungle that must tax the patience of the most expert," he said.

There are other rules that create problems. "When a system manager comes to the point where the books of an associate or subcontractor must be audited, he runs into the problem of proprietary and confidential information. We have detoured around this question by calling in the government but as a result we often find ourselves without knowledge and authority commensurate with the responsibility we have assumed."

Since private companies are doing much that was once done by the government directly, it is natural that the government should be more deeply involved in the affairs of the companies, he said.

"Day-to-day participation of government in the contractor's business was once rather mild and the policies of firms doing business with the government were designed to keep it that way. Now, many are selling a different kind of product and the ground rules have changed. We get paid not only for hardware, but for managing a vast program involving huge sums of which only a small portion actually goes for something we, ourselves, manufacture. Thus we are now doing much that government used to do, and dispensing federal funds to suppliers under contract to us. We are under the obligation to be responsible to government policy in virtually every area of our activity," Douglas said.

He said that business must learn to conform to the country's social and economic philosophies as reflected in government and that government should reward compliant companies with more responsibility and trust.

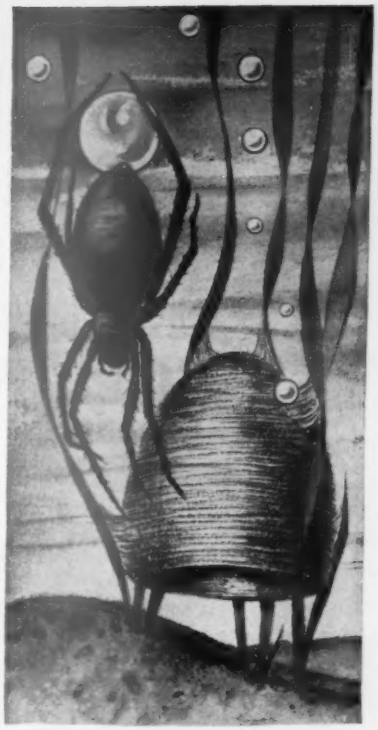
Private Enterprise

Douglas questioned the attitude of government toward defense industry and asked whether it should be regarded as true private enterprise.

"If we favor private enterprise and this feeling extends to our defense industry, do the usual prerogatives of a commercial enterprise apply? May the defense contractor develop his corporate image as an aid to recruitment of personnel, community relations and the securing of risk capital? The furor over defense contractor advertising leads me to think there is some confusion on this question," he said.

"We must make up our minds whether we are against big business as a fundamental policy or whether we recognize that the demands of some technologies are such that only tremendous organizations can rise to the challenge. Very large companies or groups of companies and a narrowing of competition may be an unavoidable part of maintaining a strong aerospace industry.

"The government quite properly is not interested in paying excessive maintenance costs to support inefficient facilitization. But will it permit, let alone foster, mergers designed to improve the situation? I don't think there is yet a clear answer." As examples of inconsistent policy, Douglas referred obliquely to the lack of government reaction to the proposed acquisition of Philco Corp. by Ford Motor Co. while the smaller Ling-Temco-Vought merger is under fire by the Department of Justice.



Engineered Environment

A good trick if you can do it and the water spider *does* . . . builds a watertight nest at bottom of a pond. She then pulls arm-loads of air bubbles down into the nest. In this air filled structure her eggs are kept free from surface enemies.

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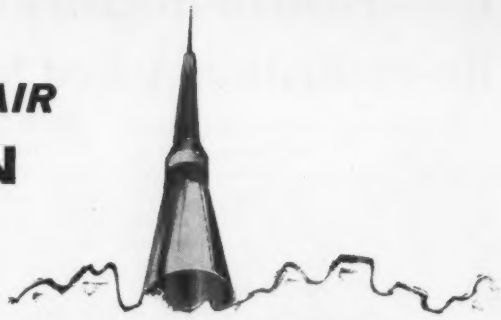
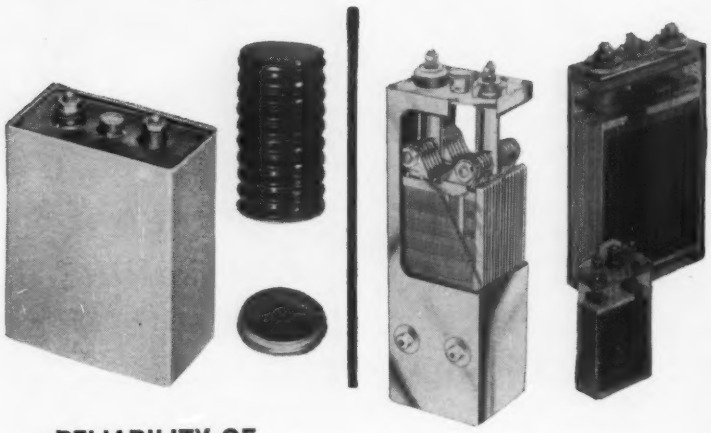
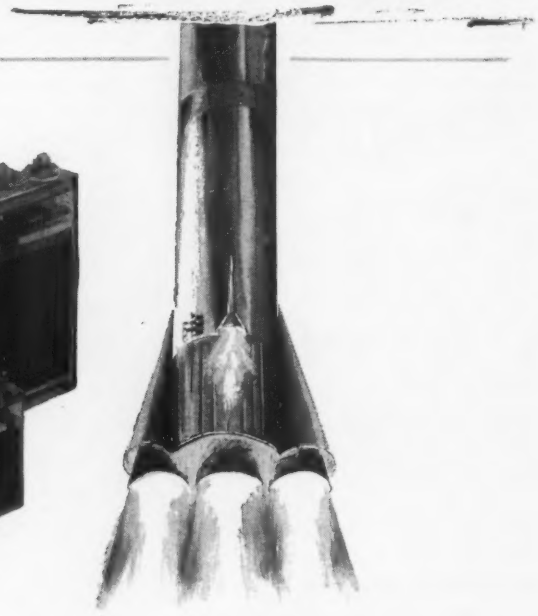
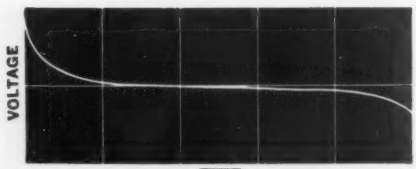






RELIABILITY OF PERFORMANCE IN ROCKET, MISSILE AND AIRCRAFT CONTROL, GUIDANCE, TELEMETERING, EMERGENCY LIGHTING, ALARMS, SIGNAL EQUIPMENT



One of the main advantages of nickel cadmium batteries, as compared with other systems, is the constant voltage during discharge—even under extremely heavy loads. Shown above is a typical discharge curve.

■ On the ground or in the air, there can be no 'second guess' in specifying a basic power source to operate the control, guidance and telemetering systems for aircraft and space vehicles. Design engineers are specifying NICAD Nickel Cadmium Vented Cells, with assurance, for their extreme reliability and uninterrupted dependability in such critical applications.

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Rocket Society Analyzes Space Problems

New York—Progress and problems in U. S. space vehicles, missions and global effects were summarized in four American Rocket Society panels at the ARS Space Flight Report to the Nation held here recently.

The panels were highlighted by:

- **Technical problems** anticipated in the Apollo manned lunar landing, discussed by Robert R. Gilruth, director of NASA's Space Task Group.
- **Military requirements** in space, reviewed by Trevor Gardner, president of the Hycon Manufacturing Co.
- **An appeal** to "think out of the groove" to solve the key vehicle problems, made by Norris F. Dow, consulting engineer for the General Electric Co.'s Space Sciences Laboratory.

Gilruth said Project Apollo will be one of the most intense efforts ever undertaken to provide simple and redundant space systems with high quality control and human consideration. He said the rendezvous technique may provide the only means of accomplishing the Apollo mission quickly, and he listed four major technical problem areas which must be overcome before Apollo can be conducted. They are re-entry dynamics, earth landing, lunar landing and vehicle performance and reliability.

Re-entry Data

Gilruth said re-entry technology data being obtained indicates the problem of protecting a crew during its 36,000-fps. re-entry velocity appears solvable. A steerable parachute or Rogallo-type surface could be used to avoid hazards in an earth landing. Lunar landing, he said, will require a genuinely soft impact, and the technology of the lunar sciences program will contribute to the solution of this problem.

Gilruth said the country is "approaching the end of the beginning" in manned space flight with Project Mercury, which has not only confirmed man's ability to function in space, but also has resulted in development of a combined Defense Department-industry-NASA management base for future programs.

Apollo will require an expanded management capacity and creation of new resources and manufacturing capabilities.

Apollo does not yet have a frozen detailed configuration, he said, however, a plan is being developed, although not yet definite, for a long-duration space laboratory, and that rendezvous may be a large factor in Apollo plans. Rendezvous problems do not include just guidance and launch vehicles, he said, but extend to the critical area of personal equipment.

Present space suit technology leaves much to be desired, since the pilot is virtually immobile in an inflated suit. The pilot feels "like he's inside a low-pressure tire," Gilruth said.

Gardner appealed for recognition of military space requirements. Bureaucratic and policy problems are hampering the military space program, he said, but the deficiency in big boosters is the same for both civilian and military programs.

The fact that today's space policy is oriented toward science is "fine," Gardner said, but military space missions are needed, and decisions for them are needed from a high level of government.

Council Inadequate

He said the relationship between NASA and the Defense Department must be tightened, and that the small Space Council is not enough.

Gardner said the projects the Soviets are conducting in space look "more and more like military" experiments, and the recent resumption of Russian missile tests "signals bigger boosters."

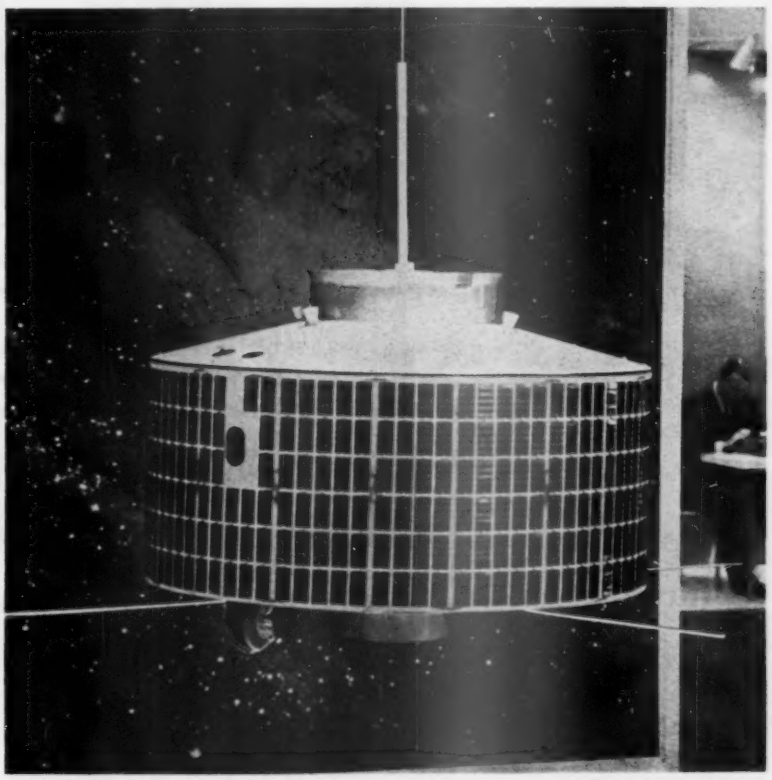
He said many military projects, particularly in nuclear energy, ballistic missiles, rockets and electronics, have developed useful civilian applications. He said there is a need to develop a system for neutralization and capture of satellites, but "no such program is under an accelerated status."

Retaliatory System

Gardner said he is not making a case for a retaliatory space weapons system, but there are a number of possibilities to think about. Among them are bombs in orbit, lunar-based bombs and "lost" space fleet, using decoy and concealment for manned space vehicles.

Dr. Oskar Morganstern of Princeton University pointed out that prospects for international cooperation in space are dim, since there are only two space powers and they are hostile. He said agreements without enforcements are meaningless, and space control will not be easier to achieve than nuclear control.

GE's Dow, urging engineers and scientists to think creatively to solve basic vehicle problems, listed these problems



HUGHES COMMUNICATION SATELLITE, being developed for NASA under Project Syncom, is expected to weigh about 60 lb. First launching of the satellite is scheduled for about one year from now.

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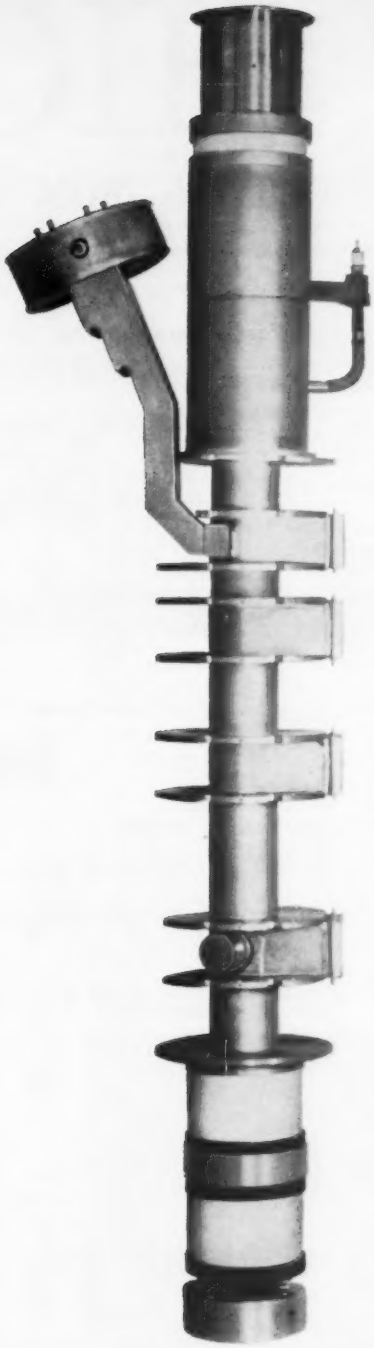

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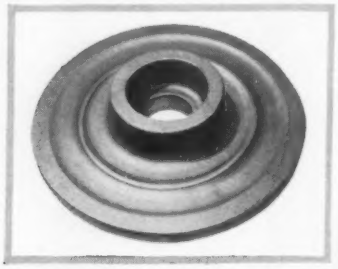
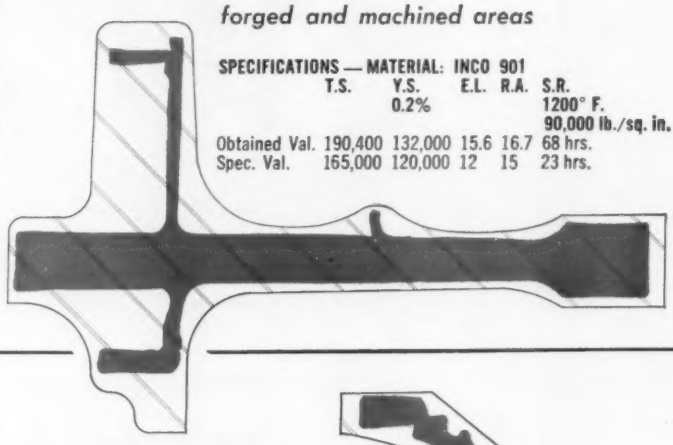
DISC TURBINE WHEEL and half cross section showing forged and machined areas

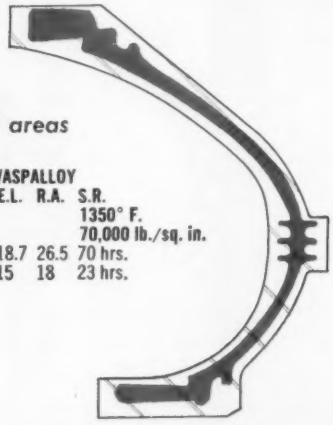




SPECIFICATIONS — MATERIAL: INCO 901

	T.S.	Y.S. 0.2%	E.L.	R.A.	S.R. 1200° F. 90,000 lb./sq. in.
Obtained Val.	190,400	132,000	15.6	16.7	68 hrs.
Spec. Val.	165,000	120,000	12	15	23 hrs.

THERMAL SHIELD TURBINE ROTOR and half cross section showing forged and machined areas



SPECIFICATIONS — MATERIAL: WASPALLOY

	T.S.	Y.S. 0.2%	E.L.	R.A.	S.R. 1350° F. 70,000 lb./sq. in.
Obtained Val.	190,800	143,000	18.7	26.5	70 hrs.
Spec. Val.	160,000	110,000	15	18	23 hrs.

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as radiation, re-entry and rendezvous. He suggested electrostatic deflectors for radiation shields; Rogallo-type devices to broaden the re-entry corridor two or three times, and rendezvous while in a lunar orbit to decrease the effects of gravity in an earth orbit.

An electrostatic shield can be effective, he said, if a system can be developed which can generate 20,000 volts per cubic centimeter. Refractory fabrics can survive re-entry heat loads.

Willis M. Hawkins, vice president and general manager of Lockheed Missiles and Space Co., said vehicle problems center around insufficient knowledge and the fact that dollars are made available for space programs one year at a time.

He said the U. S. "has a long way to go in reliability," particularly in safety, durability, and life support systems. He suggested investigation of "human storage" or hibernation for lunar and Mars missions, since less than half the life support materials will be required with this technique.

Simple Satellite Needed

John R. Pierce, director of research for Bell Telephone Laboratories, said communications appears to be the only space field with direct commercial applications. He said tremendous advances are required in reliability and predictability, and a simple satellite, with a maximum of 1,000 components, may be the best approach.

Gilruth said it is extremely difficult to assess Cosmonaut Gherman Titov's reported illness during his flight. He said Soviet cosmonauts "are considerably younger and less experienced" than those in Project Mercury and this may be a factor in his reactions to the flight.

Gilruth said he is not certain that inner-ear illness will be encountered by all astronauts and he is not convinced of the need for artificial gravity for extended manned space flights.

Don G. Mitchell, vice chairman of the board of General Telephone and Electronics Corp., said industry's major challenge is to recognize the opportunities of space when it sees them. He said space science and technology will surpass the industrial benefits of nuclear physics and electronics, particularly in the areas of:

- **Propulsion,** which will be affected through new chemical techniques and processes developed for rocket fuels. Simple and highly efficient powerplants for aircraft and automobiles and new concepts in power generation will result.
- **Instrumentation,** which will benefit from electronic hydraulic and mechanical systems used in space vehicles. Electronics has brought with it strong emphasis on miniaturization and microminiaturization.
- **Bioastronautics,** which may answer many medical and health problems while it solves problems of man's survival in space.

Industry will benefit from re-entry materials research, and possibly from the ability to harness radiation, Mitchell said.

He pointed to the great potential in communications satellites as a solution to the growing problem in overseas communications. Number of calls from the U. S. to the rest of the world, which will number four million this year, will grow to 100 million by 1980, Mitchell said.

U. S. and Soviet space programs were evaluated at an evening session during which the panel moderator, Arthur Clarke, past chairman of the British Interplanetary Society, put 16 questions to a group composed of Dr. Hugh L. Dryden, NASA deputy administrator; Gen. Bernard A. Schriever, Air Force Systems Command commander; F. J. Krieger, Rand Corp.; Dr. Arthur Kantrowitz, Avco Corp. vice president, and Dr. Wernher von Braun, director of NASA's Marshall Space Flight Center.

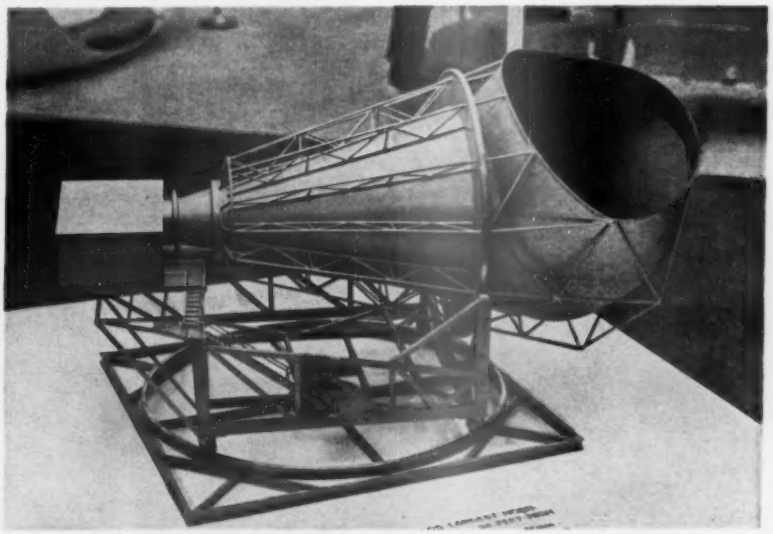
Midway through the discussion, Kantrowitz and Dryden stated sharp and opposing views on the military and civilian uses of space. "It is a fiction to say that there are two space programs, one military and the other civilian," the Avco scientist said. He pointed out that space technology is basic both to the military and civilian programs and, as such, there should be one over-all national effort in space. Dryden, admitting that there was a definite military role in space, countered by saying that the end applications of military and civilian programs differed and therefore necessitated separate efforts. Many observers thought it significant that Kantrowitz's remarks drew heavier and longer applause from the many hundreds of ARS members and general public in the audience.

The question of the rendezvous technique came up again at this panel session, as it did frequently throughout the week-long ARS meeting. "We will make a decision by Christmas time," Dryden said, "as to whether this technique will be our main line of attack." Kantrowitz asked von Braun why the U. S. is not exploiting its present launch capability—with vehicles like the Atlas or Titan—to achieve an early ability for rendezvous (AW Sept. 4, p. 60).

Apollo Launch

Von Braun answered that it would require about 400,000 lb. in orbit to launch an Apollo vehicle of 150,000-165,000 lb. on a lunar mission. To assemble that weight in orbit, von Braun said, would require around 100 Atlas or Titan boosters and the problem would be similar to "flying the Berlin airlift with Piper Cubs." Dryden said that NASA had studied the possibility of using existing missiles for rendezvous but was "appalled at the material and logistics problems involved" and that the prospects of assembling 100 or more pieces in space was "frightening." Both Dryden and von Braun agreed that no more than two or four rendezvous missions could be handled conveniently in the assembly of an orbiting space support facility for Apollo vehicles.

Clarke said that Soviet Premier Khrushchev had boasted recently that the USSR would soon place 50 tons in orbit and asked the panel members how soon they thought the Soviets and the



BELL TELEPHONE SYSTEM'S space communications ground system near Rumford, Me., will feature this horn for beaming communications to satellites and receiving from them. The horn is 177 ft. long and 94 ft. high, and weighs 250 tons. Construction is currently under way on the ground station.

U. S. would accomplish this feat. No panel member ventured a guess on target dates, but Gen. Schriever noted that "they [the Soviets] have yet to say that they intended to do something and then failed to produce as promised. I wouldn't be surprised if they achieved 50 tons in the near future."

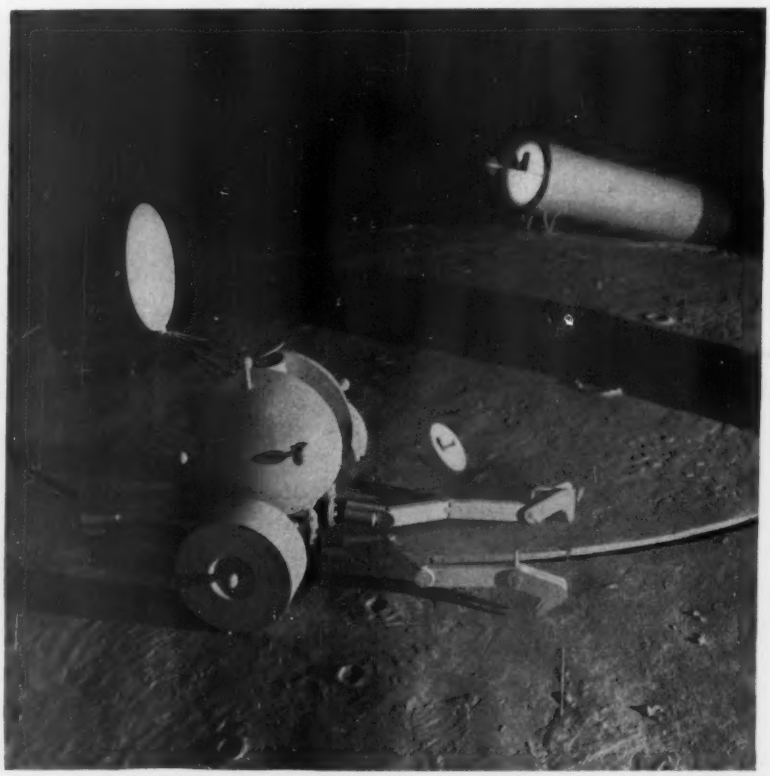
Dryden said that the Soviets have shown continual improvement in their booster systems, going from four to seven ton payloads. Von Braun described the booster competition between the two nations as a "leap-frog" business and said that the U. S. now has a project under development that could lift "double 50 tons" into orbit—presumably the Saturn C-4 vehicle.

In discussing the time, money and scientific talent that U. S. industry devotes to the ritual of proposal making, all five panel members agreed that this was wasteful but unavoidable in a free enterprise system. Von Braun said that he had recently talked with Leonid I. Sedov, USSR Academy of Science, and asked the Soviet scientist which agency in the USSR reviews new proposals. "Unfortunately," Sedov replied, according to von Braun, "we do not have the problem." The Soviet scientist went on to say, von Braun reported, that "the collectives must be periodically stirred up" to abandon old, proven systems and to start development on new concepts. "Where we may have too much competition," von Braun said, "it would appear that the Soviets may have too little."

Discussing global communications systems, Krieger said that current Soviet literature contains many references to communications satellites but that he believed that this was a sop for the Russian people and not an indication of any Soviet competition for the U. S. in this area. "Besides," the Rand physicist said, "a communications satellite system would complicate their security program" by providing other nations with another means of broadcasting uncensored news to the Soviet people.

Dryden noted that it was an interesting side facet of the Soviet program that the USSR has not launched a general scientific payload since Sputnik III; all subsequent satellites and missions have been in direct support of manned space flight.

The charge that the U.S. has tended to emphasize the machine, rather than the man in space, was denied by the NASA deputy administrator. "Both NASA and the Defense Department from the beginning have agreed," Dryden said, "that no space program could be complete without man." Gen. Schriever added that man was an essential part of space exploration and cited the X-15 program as an example where some vehicles would have been lost had a man not been used in the system.



LUNAR ROVER CONCEPTS developed by Radio Corp. of America engineers were featured at American Rocket Society's Space Flight Report to the Nation. Larger rover shifted weight to three legs (above) to lift and advance fourth; smaller concept used third set of legs to maintain stability during walking. Sperry Gyroscope's concept of a Prospector roving lunar vehicle (below) consists of two hemispherical compartments, mounted above two driving spun-wire, core metal fabric wheels. A smaller diameter auxiliary wheel is located to the rear of the vehicle. Projecting above and behind the vehicle is a solar collector; ahead is a communications antenna. Between the hemispheres is a launch tube for the return rocket that would bring back to earth data and samples of the lunar environment. Knobs located about the vehicle's waist are sensors and a television camera is positioned atop one of the hemispherical compartments. Sperry says that some of the extendible equipment could be folded into the gap between the hemispheres for launching.

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Micro-organisms Die In Space, Tests Show

Recent vacuum chamber tests at Hughes Aircraft Co., Culver City, Calif., indicate micro-organisms cannot survive long in a space environment and that it may be possible to eliminate the expensive practice of sterilizing space vehicles.

The tests were made in a facility which includes high vacuum pumps, multiple test chambers, liquid nitrogen traps and provisions for collecting and analyzing outgassed or evaporated products, as part of a company-funded space environment study program.

Only a comparatively few types of micro-organisms out of hundreds of thousands known to exist have been tested in the program, but Hughes scientists feel it is significant that not a single one tested could withstand prolonged space exposure.

Some organisms remained viable after exposure for 10 days at a pressure of 8×10^{-6} mm. Hg, equal to 200 mi. above the earth, but all specimens died after exposure for 30 days at pressures of 1.2×10^{-6} to 6×10^{-6} mm. Hg, equal to 300 mi. altitude.

The vacuum facility, constructed by Hughes' laboratory staff, can simulate high vacuum, the heat sink of space, thermal extremes and visible, infrared, ultraviolet and high energy radiation. One portion will reproduce the nearly pure vacuum on the moon.

Made entirely of Pyrex glass, the apparatus uses mercury diffusion and ion pumping. The system is regularly maintained at 5×10^{-7} mm. Hg. (250-mi. altitude) through use of special valves and cement sealed ground glass joints. Pressure in any chamber or series of chambers can be ion pumped to 1×10^{-8} mm. Hg. (450 mi. altitude). System can be run continuously for months.

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Convention Recruiting Ban Favored by Firms

More than 75% of a total of 200 companies recently queried would favor a ban on recruiting engineers and scientists at technical conventions, and 87% of those surveyed said they would abide by a general industry agreement to halt convention recruiting. Majority of the companies is in aerospace and electronics fields. Of companies surveyed by Deutsch & Shea, Inc., an advertising company in New York, 65% now recruit at conventions.

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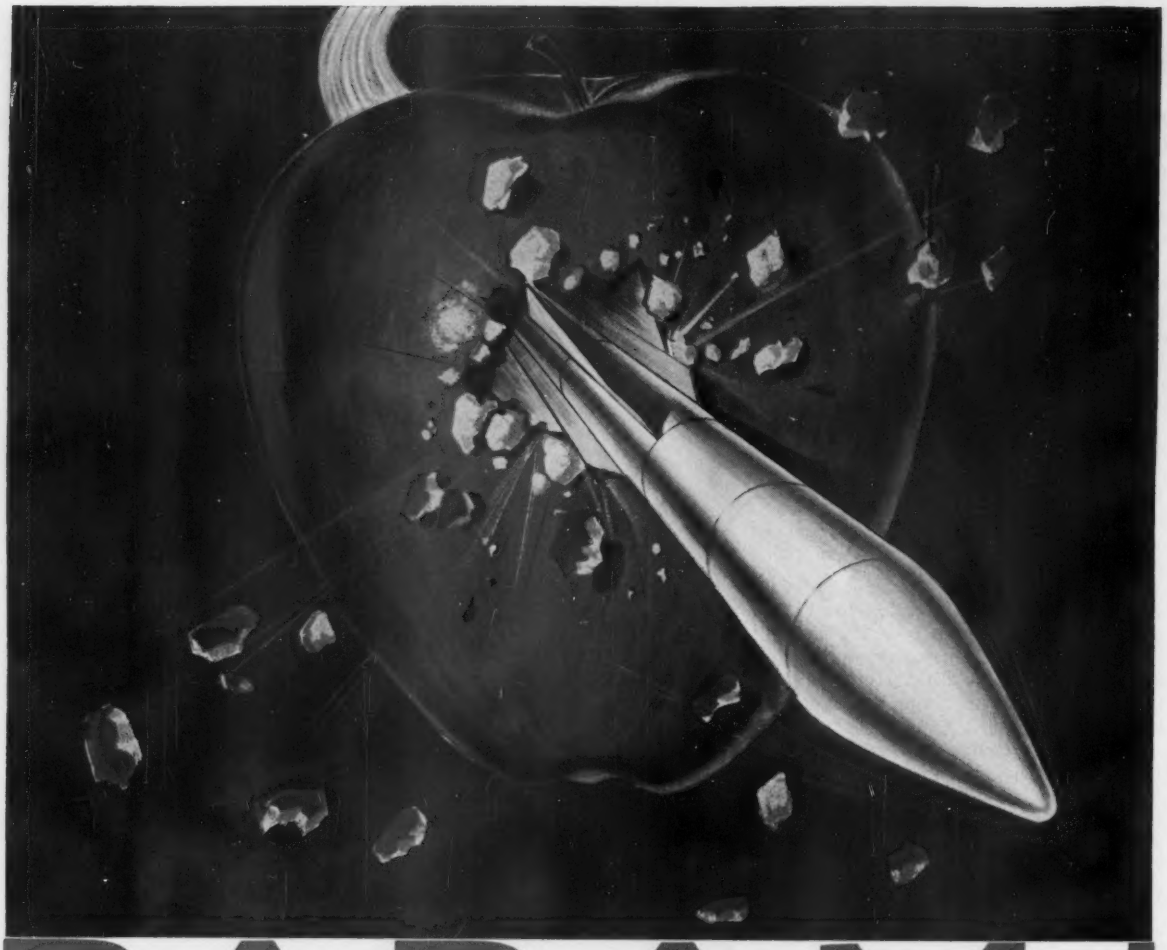

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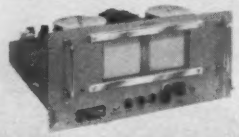

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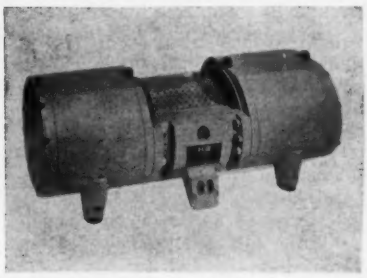

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International Telephone and Telegraph Corp., Industrial Products Division, San Fernando, Calif.

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Unit price: $99.95.

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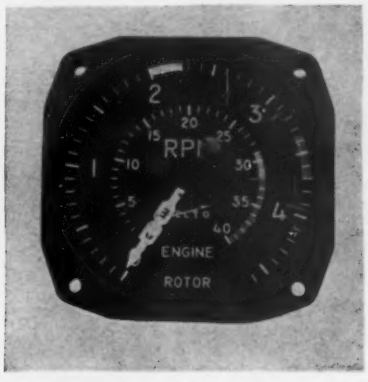

Helicopter Dual Tachometer

New Vecto Model #60 has rotor rotation calibrations on the outer scale and engine crankshaft speeds calibrated on the inner scale. Priced under $160, the new dual tachometer has recently been accepted as standard equipment on Hiller helicopters.

Rotor rotation speed is calibrated from 0-450 rpm., and engine crankshaft speeds from 0-4,000 rpm. Range markings are provided by Vecto based on helicopter manufacturers' engineering-performance specifications.

Vecto Instrument Corp., 8124 Lockheed, Houston 32, Tex.

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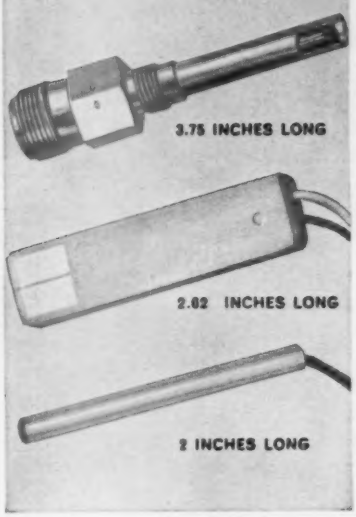

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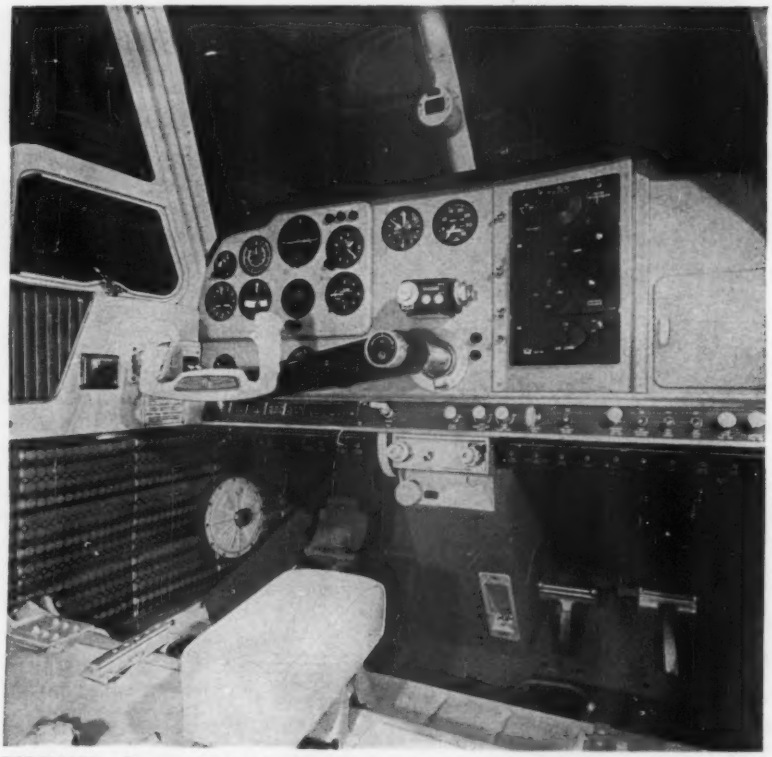
LATEST MODEL 65 Queen Air carries a useful load of up to 3,060 lb., an increase of approximately 20 lb. over the previous model.

Beech Revising Plane Promotion Methods



DEBONAIR radio grouping is placed on a panel tilted outward to provide man on the left seat with improved vision and ready access to the controls.

By Erwin J. Bulban

Wichita, Kan.—Simultaneous mass unveiling of a complete line of business aircraft is being abandoned by Beech Aircraft Corp. for the 1962 model year. The recent management decision is intended to ease pressures on the company and its field organization which it feels seriously hamper sound engineering and marketing programs.

Introduction of the 1962 versions of the Model 33 Debonair single-engine four-seater and the Model 65 Queen Air medium-heavy twin this month follows the pattern which the company is experimenting with in its program.

Basically, the Beech plan calls for:

- **Dropping the traditional** annual international sales meeting attended at the factory here by hundreds of distributors, dealers and their sales and service personnel and substituting instead a program of taking several models at a time over an extended period directly into the field for introduction at the distributor-dealer locations.
- **Holding the line** on aircraft modifications for the sake of merely distinguishing a "new model from the previous year's version" and instead, feed these innovations in on a more routine basis in the course of a model's life span.

Indications are that considerable pres-

MODEL B-33 DEBONAIR optional fuel tankage is 10 gal. for a total of 80 gal., permitting flights of 1,135 mi., nonstop.

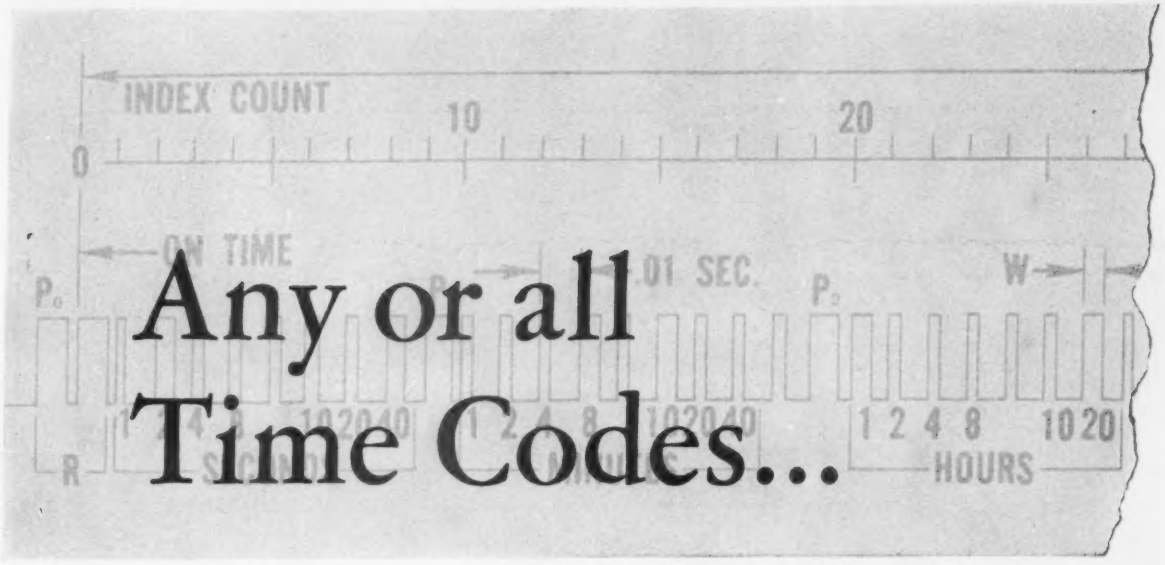
sure has been exerted on Beech management by its influential distributors to steer this new course. For one thing, the traditional annual meetings have grown over the years to the stage where the field organizations have felt it necessary to have a number of their key personnel attend if the various segments of their operation—for example their individual product managers—were to obtain maximum use of the opportunity.

Since attendance could stretch out over a week's time, or perhaps longer, absence of these people from their primary sales and service responsibilities back home was keenly felt. A common sight at such a meeting was paging of numerous attendees and their scurrying to handle long-distance calls from their home offices relating to a problem that had come up requiring their personal attention. In some cases, a prospect who had been vacillating for a considerable time would decide that this was just the time he would like to make his decision to purchase.

Attending these meetings also became costly in travel, entertainment and living expenses for the distributor-dealer and the parent company. They posed a considerable strain on the manufacturer for weeks in advance of the meeting in making preparations.

Distributors and dealers feel that the practice of making the previous models "obsolete" yearly placed a tremendous financial strain on their organiza-

FRONT SEATS of 1962 Beechcraft Model B-33 Debonair have been redesigned to provide four-position inclination and three-position fore and aft movement. Price of the basic Debonair is $21,975, approximately $225 higher than last year's airplane. Company, however, has developed an optional equipment package at a factory-installed price of $3,250, that provides a saving of $700-800 over earlier purchasing system.



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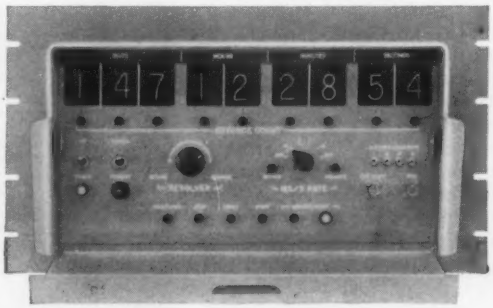

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Model 65 Queen Air

Powerplants	Two Lycoming IGSO-480-A1B6 at 340 hp. ea.
Gross weight	7,700 lb.
Empty weight	4,640 lb.
Useful load	3,060 lb.
Top speed	239 mph.
Cruise speed (70% power)	214 mph.
Cruise speed (65% power)	210 mph.
Range (with reserve, 65% power, 200 mph.)	1,070 mi.
Rate of climb (2 engines)	1,300 fpm.
Rate of climb (1 engine, 7,000 lb. weight)	365 fpm.
Service ceiling	31,300 ft.
Stall speed (gear down, flaps down 30 deg.)	80 mph.

tions. This was accentuated by the trend in recent years of the various companies striving to expand their lines to engage in outright competition with other manufacturers all through the product lines.

The problem of stocking sufficient demonstrators, fully equipped, and the prospects of being caught with an inventory of the previous year's models because customers became aware that a new model year was coming up was emphasized last year. Sales slid sharply as a result of the U. S. general business recession and many members of the field organizations were hard-hit because of lack of ready capital to maintain day-to-day operations because they had so much tied up in demonstrator and sales inventories.

High-level Beech management also feels that the urge to have "something new" in each model every year puts an artificial pressure on its engineering department, which often had to reduce efforts on long-term programs to meet tight deadlines regarding incorporation of some minor improvement.

The new program probably will result in concentration on developing really worthwhile improvements under less deadline pressure for incorporation every two or three years. Such will be particularly the case in the more expensive twin-engine airplanes, inventories of which are particularly sensitive to the annual "forced obsolescence" practice.

Beech management personnel emphasize that the current decision is an experiment, since the competition may decide whether the company will be able to continue this course. But indications are that this program dovetails into the company's current long-range product development plan. The plan spells out in some detail the model line over the next few years and forecasts the evolvement of the current basic line of business airplanes, continuing production of some models with improvements, discontinuing production of other models and replacement of these with completely new types. As part of this future growth, the drawing boards already detail particular styling characteristics the company is striving for that will promote the "Beech family of airplanes" concept.

The 1962 Debonair, for example, points up one aspect of this design aim in its swept vertical tail which follows the general line of the Baron light-twin.

This decision to postpone model changes except for important improvements is not a radical innovation in the industry—Aero Commander is a contemporary example of a firm which has followed this policy for years. But industry observers are particularly interested in seeing how one of the big three —Beech, Cessna and Piper—fares in this approach.

Presentations of the 1962 Debonair and Queen Air are being made across the country by two Beech factory teams in 12 key areas. One team covers the eastern portion of the tour and comprises Vice President-Marketing Wyman L. Henry, Marvin Small, Larry Ball and Jack R. Carlin, the other covering the western section and comprising Vice President-Domestic Sales Leddy Greever, Thomas W. Gillespie, Michael M. Gordon and W. F. Balzerick. Each two-day stop will brief an attendance of 35-60 dealer-distributor sales and service personnel.

Important innovations in the pair of new business airplanes include:

• **Increase in range** for the Model B-33 Debonair four-place aircraft with optional fuel tankage up 10 gal. for a total of 80 gal., permitting flights of 1,135 mi. nonstop, including allowance for warm-up, taxi, takeoff, climb to altitude and 45-min. reserve. Last year's A-33 had a range of 1,150 mi. without any of the above allowances.

• **Price of the basic Debonair** is $21,975, approximately $225 higher than last year's airplane. But the company has developed an optional equipment package at a factory-installed price of $3,250, which covers most of the items previously ordered by customers, that provides a savings of some $700-800 over the earlier system of purchasing units on an individual basis. Equipment consists of a Beech Power Flite Control/Tactair autopilot marketed under the Beech name, gyro horizon, and directional gyro, with complete vacuum system, instrument kit comprising electric turn-and-bank, rate of climb indicator, clock, outside temperature gage and cylinder head temperature gage, a 50-amp. generator, right-seat rudder pedals, auxiliary wing fuel tanks, additional soundproofing and a Motorola T-12 ADF.

• **Radio grouping** is placed on a panel tilted to provide the man in the left seat with improved vision and ready access to the controls. Instrumentation

B-33 Debonair

Powerplant	Continental IO-470-K at 225 hp.
Gross weight	3,000 lb.
Empty weight	1,745 lb.
Useful load	1,255 lb.
Top speed	195 mph.
Cruise speed (75% power)	185 mph.
Cruise speed (65% power)	180 mph.
Range (with reserve, 65% power, 180 mph.)	1,135 mi.
Rate of climb	960 fpm.
Service ceiling	18,400 ft.
Stall speed (gear down, flaps down 30 deg.)	60 mph.

section is designed so that loosening a single fastener permits swinging the entire group down for access.

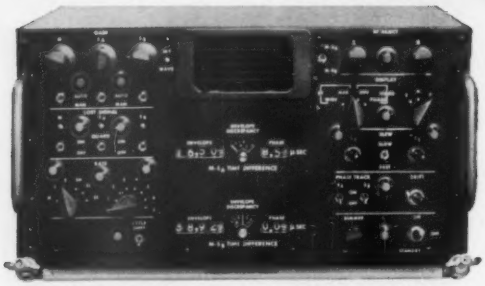
• **Front seats** have been redesigned to provide four-position inclination and three-position fore-and-aft movement. Larger wheel brakes, comparable to the Bonanza, are used in the new model.

• **Useful load** on the 1962 Queen Air is up to 3,060 lb., an increase of approximately 20 lb. over the previous model. Gross weight for the six-to-eight passenger aircraft remains at 7,700 lb. Revised cabin interior provides 10 cu. ft. additional space and allows a baggage area of 29 cu. ft., having a capacity of 350 lb. Beech is retaining last year's price of $126,000 for the basic model of the Queen Air in the current airplanes, attributing the hold-the-line on costs to increased production rates. Since last May, factory sales on the Model 65 have averaged 13 monthly.

Beech Sales Exceed $70 Million in FY '61

Total sales exceeding $70 million for the fiscal year ended Sept. 30 are reported by Beech Aircraft Corp., down markedly from the previous year's $98.7 million. The decline is attributed to phaseout of important military subcontract work and slowdown in business aircraft sales which the industry experienced as a result of the U. S. recession. The company declared a 15-cent cash dividend and a 2% stock dividend, the former to holders of record Oct. 20 and the latter determined by last sale or closing bid price on the same date.

Company reports increased participation and private study programs in aerospace developments including Apollo, Saturn, Centaur and Titan and says that it is currently negotiating a multi-million dollar follow-on military contract and expects to complete negotiations on an Army production order this month. Its four-place PD-169 $12,000-class business plane project is in preliminary phase of flight test.



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For further information contact "Marketing Department," ITT Federal Laboratories, 500 Washington Avenue, Nutley, New Jersey.

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ADDITIONAL CABIN WINDOWS and saw-tooth louvers beneath engine nacelles distinguish Cessna 320 Skyknight from earlier 310F.

Aviation Week Pilot Report:

Good Controllability Is Cited in Skyknight

By David A. Brown

New York—Cessna Aircraft Corp.'s Skyknight, a turbo-supercharged light twin designed primarily for business owners who want high altitude performance in a low-cost aircraft, proves itself in flight to have excellent controllability at low speeds and in unusual attitudes.

The five-place airplane is forgiving of pilot errors and performs well through a wide range of flight conditions.

Follow-on Model

Designated Model 320, the Skyknight is a beefed up follow-on to the non-supercharged Model 310F (AW May 22, p. 92). The Skyknight is built around the basic 310F structure, with changes where necessary to incorporate improvements.

Modifications in the new Cessna aircraft include:

• **Wing and nacelles**—The basic 310F wing structure has been modified in the region around the engine nacelles to accommodate the added weight of the new nacelle and the exhaust-driven turbo-superchargers. The nacelle augmenters and the muffler have been removed and the 22½-in. deep nacelles faired into the wings. "Saw-tooth" louvers underneath the nacelles house manually operated cowl flaps which control engine operating temperatures. Engines are mounted on rubber shock mounts and a new exhaust system employs expansion bellows between each cylinder exhaust outlet and at the rear of the engine. A stainless steel protection shroud and firewall separates the engines and the turbo-supercharger from the wing structure. Two air inlets have been added to each wing, one inboard and one outboard of each nacelle. The outboard inlet provides coolant air to the supercharger turbine and surrounding area, but Cessna says there is no major heat problem regarding turbine operation. The inboard inlet supplies ram air to the turbo-supercharger. In addition, there are two automatically operated auxiliary supercharger air inlets. They are upstream from the supercharger air filter and can circumvent a clogged filter or inlet. Each nacelle has two underwing outlets, one for engine exhaust and a second for the automatic supercharger exhaust waste gate, which holds engine operation to a maximum of 35 in. Hg. manifold pressure regardless of throttle or mixture setting, altitude or pressure.

• **Fuselage**—Skyknight's fuselage has been deepened 3½ in. from the station immediately aft of the pilots' seats to the rear of the airplane. Most noticeable effect of this is the increased headroom and leg room available for the fifth passenger. The two passengers immediately behind the pilots also benefit from increased room.

• **Empennage**—Angle of incidence of the elevator has been changed from the 310F's −1 deg. 44 min. to 0 deg. Effect of the change is to give the Skyknight a more "on the step" ride and to eliminate some drag found in the earlier model.

• **Engines**—Skyknight is powered by two Continental TSIO-470-B horizontally opposed, six-cylinder fuel injection engines, equipped with AiResearch Model T-1106 turbo-superchargers. The turbo-superchargers enable the engines to maintain their full rated output of 260 hp. at 2,600 rpm. and 35 in. Hg. manifold pressure to a critical altitude of 16,000 ft.

To evaluate the Skyknight, this AVIATION WEEK pilot flew aircraft N 5702X with Cessna pilot Tony Lanbarkis in the New York City area.

Engine starting is simplified by the use of separate automobile-type key starter switches for each engine. Switch positions from left to right are Off-Right-Left-Both-Start. The optional oil dilution system is actuated by pressing in on either switch.

Takeoff Procedure

Starter switches were moved to the start position as the fuel flow gage indicated 2 to 4 gph. flow and the engines, warm from previous use, caught almost immediately. Magnetos were checked for a maximum permissible drop of 125 rpm. on the end of the runway and the propellers were exercised by

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moving the pitch control levers slightly into the feather detent on the center console. Fuel tanks were about half full and the aircraft was carrying three persons, full radio gear and a small amount of baggage.

The Skyknight broke ground after a run of slightly less than 10 sec. on Runway 13 at LaGuardia Airport. Outside air temperature at the surface was measured at 80F and wind was from the south at 10 kt. A heavy smoke haze in the area extended to 5,000 ft. and prevented a maximum climb from takeoff. The Skyknight climbed the first 5,000 ft. holding 135-140 mph. with the engines pulling 29 in. Hg. manifold pressure until the haze was topped, then the throttles were firewalled and the engine speed increased to 2,600 rpm. and manifold pressure to 35 in. Hg.

Indicated airspeed in the maximum climb was 120-123 mph. and the airplane was trimmed to hold a climb of 1,800-1,850 fpm. hands off. The Skyknight climbed from 7,000 to 8,000 ft. in 35 sec. and from 11,000 to 12,000 ft. in 34 sec. The engines showed no decrease in performance to 15,000 ft.

At 15,000 ft. altitude, the Skyknight reached an indicated 200 mph. in level flight with the engines pulling just under 35 in. Hg. and the outside air temperature at 40F, or about 35F above standard. The IAS converted to a true reading of 262 mph. At 75% of power, the Skyknight indicated 183 mph. or 240 mph. true and at 60% of power the aircraft indicated 176 mph. or 231 true.

Supercharger operation at altitude was slightly in excess of the operation manual rating. The superchargers are rated as being capable of maintaining 29.3 in. Hg. manifold pressure at 70% of power at 20F and actually pulled 29.5 in. at 40F.

The right engine was shut down at altitude and the Skyknight was trimmed for level flight. Hands off, it maintained a straight and level path, indicating 127 mph. with the left engine operating at 2,300 rpm. and pulling 24.5 in. Hg. The aircraft would climb in the same configuration at 120 IAS and gain 500 fpm. Outside air temperature at the time still was 40F.

Stall Maneuver

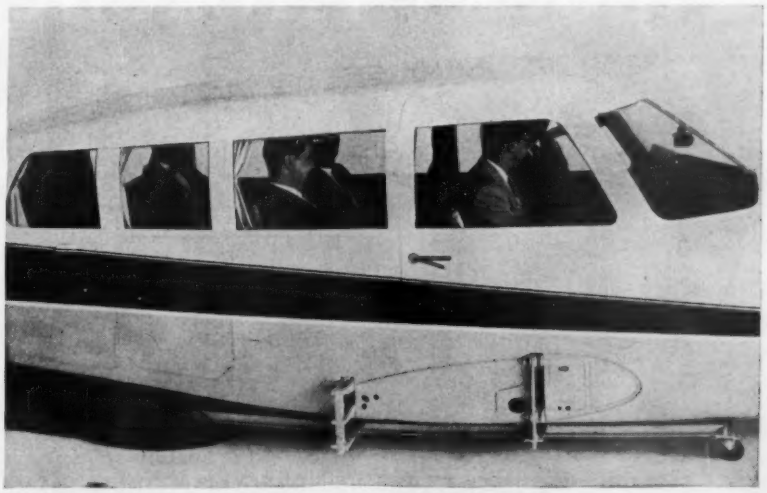
The Skyknight then was taken down to approximately 5,000 ft. altitude and put through a series of stalls in various attitudes and configurations.

Power-on stalls first produced a "rocking horse" stall similar to the type experienced under the same conditions in the 310F. The stall warning horn sounded approximately 8 mph. above the stall and was accompanied by a noticeable and unmistakable buffeting. The Skyknight stalled straight ahead and began a porpoising motion in which it stalled and recovered repeatedly without appreciably losing altitude.

The Skyknight then was stalled power-off and the wheel held back until after the nose had fallen completely through the horizon. Again the aircraft stalled straight ahead and recovered with power after an altitude loss of approximately 400 ft. In both cases, the Skyknight stalled at a slightly lower indicated air speed than the 86 mph. indicated in the handbook.

With gear down and 30 deg. flaps, the Skyknight was able to hold 65 mph. IAS without a buffet and with gear and 45 deg. flaps, the aircraft flew at 64 mph. without a buffet.

The right engine again was shut down and the aircraft stalled in landing configuration (gear down, 45 deg. flaps)



SKYKNIGHT CABIN has seating arrangement similar to 310. Fifth seat is optional. Standard configuration has joined rear seats which will accommodate three persons.

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Microdot Awarded Contract on Midas

LOS ANGELES, CALIF.—Contracts in excess of $225,000 have been awarded to Microdot Inc. by Philco Corporation's Western Development Laboratories for UHF narrow-band data link transmitters and subassemblies to be flown in the Midas missile alarm satellites.

The Midas project, under cognizance of the United States Air Force, is aimed at development of a national early warning capability through multiple satellite coverage of the earth's surface via infrared detectors. Philco, with responsibility for the instrumentation, is an associate contractor to the Air Force. Lockheed Missiles & Space Company, prime system contractor, is responsible for the total vehicle and ground elements of the system, integrating associate and subcontractor efforts.

Microdot model 2406A UHF Telemetry Transmitter, similar to units now in production for the Midas satellite program.

In May, 1960, a Midas satellite was launched into near perfect orbit 300 miles in space. The 5000-pound satellite, over 21 feet high, carried a 3600 pound instrumented package. Then in July of this year, Midas III was placed into an 1850 nautical mile orbit. Again a near perfect circular orbit was achieved. Continuation of test firings are anticipated with the program remaining a high priority national development.

For Midas, Microdot will supply their Model 2406A Telemetry Transmitter modified to include self-monitoring and telemetering of its own operation. The transmitter is miniaturized, pressurized, and includes its own solid state power supply. Reduction in size is gained through use of a unique automatically stabilized circuit, with the output frequency referenced directly to a quartz crystal. The transmitter weighs 12 pounds. Similar Microdot telemetry equipment has been a part of such projects as Pioneer V, Jupiter, Atlas, Pershing, Redstone, and Echo I.

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both in straight flight and in an approximate 60 deg. bank. With the left engine delivering 75% of power, full left aileron and nearly full left rudder counteracted the Skyknight's natural tendency to turn into the dead engine as it stalled from straight flight.

Directional control was maintained throughout all stalls, however, with aileron control especially being effective at low speeds. The Skyknight's 51-gal. tip tanks act similar to wing end plates in channeling air flow over the ailerons at low speeds.

During a steep turn into the good engine in landing configuration, the Skyknight refused to make a sharp stall, and, although shuddering, mushed on through the turn.

At 75% of power on one engine at 5,000 ft., the Skyknight would climb at 85 mph. IAS at 500 fpm.

Landing Procedure

Landing at Teterboro, N. J., airport was made under marginal conditions due to heavy smoke pall coming from a large fire nearby.

At 160 mph. IAS, 15 deg. flaps were lowered and the landing gear and full 45 deg. flaps were lowered at 140 mph. IAS. The Skyknight normally flies approaches at 120 mph. IAS, descending at 900 fpm. Over the fence speed was 90 mph. and the aircraft touched down at 65 mph. into a 10 kt. headwind. Teterboro tower advised that the field temperature was 78F. The Skyknight slowed quickly and could easily have made the first taxiway turnoff with a bit more braking.

Throughout the flight, the Skyknight equaled or exceeded published figures on performance, which Cessna says were made conservative.

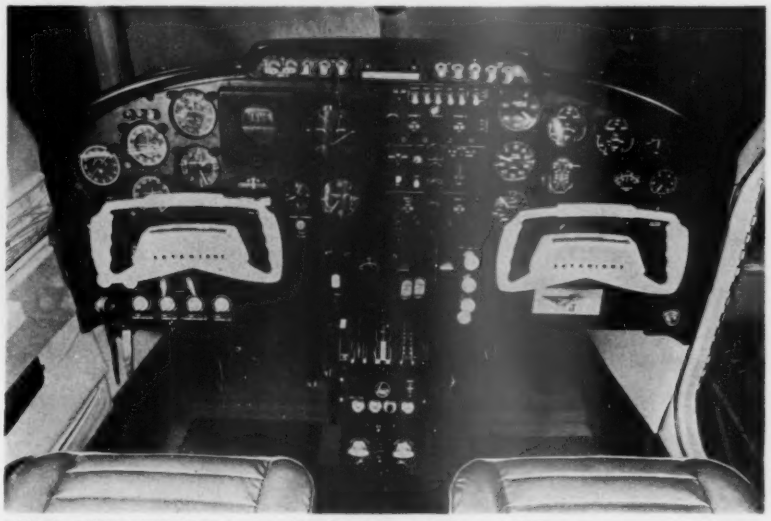
Instrument Panel

Arrangement of the instrument panel allows both pilots to see all gages with ease. Flight instruments are grouped in front of the pilot and engine instruments are grouped in front of the copilot. Radios are centered and a center console contains throttle, propeller and mixture controls, trim, autopilot and cowl flap controls.

Starting controls and light switches are to the left of the pilot's control wheel and low and thus may be somewhat out of the way for the copilot. Other switches, however, are grouped across the top of the panel and are within the reach of either pilot. The emergency landing gear extension crank is located in a stowage clip to the right of the pilot's seat.

The Skyknight was designed to fill a gap Cessna planners see in the already rather crowded light-twin field. Engineers were called upon to produce an aircraft with high-altitude performance comparable to higher-priced, super-

SKYKNIGHT FUSELAGE has been deepened 3½ in. aft of pilot's seat, giving cabin bulkier appearance. Wing and empennage are basically the same as the 310F.



PANEL ARRANGEMENT is virtually identical with that of 310F. Engine cowl flap controls are below autopilot on center console. Airfoil-shaped ignition/starter switches beneath pilot's control wheel actuate oil dilution system when pressed.

PILOTS' SEATS in the Skyknight (right) adjust fore and aft and tilt. Standard rear seats recline. Note optional table in back of copilot's seat.

How many of his dreams do you share?

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Write to Northrop Corporation, P.O. Box 1525, Beverly Hills, California, and mention your area of special interest. You will receive a prompt reply.

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Skyknight Performance

Top speed	265 mph.
Cruise speed	245 mph.
Best cruise altitude	19,000 ft.
Twin-engine rate of climb	1,850 fpm.
Single-engine rate of climb	400 fpm.
Twin-engine service ceiling	27,200 ft.
Single-engine service ceiling	17,300 ft.
Takeoff run on a standard day	870 ft.
to clear 50 ft. obstacle	1,470 ft.
Landing roll on a standard day	640 ft.
to clear 50 ft. obstacle	1,770 ft.
Fuel consumption at 19,500 ft. at 75% power	28.6 gph.

Notes: All performance calculated for maximum gross weight of 4,990 lb. Standard day conditions are 59F at sea level with no wind.

charged twins, at a selling price not far above the 310, and with a seating capacity more nearly in line with what Cessna believes is the average for business flights.

First deliveries of the Skyknight were made in August. The aircraft sells for $67,500, less radio and optional equipment. This is $5,000 more than the 1961 Model 310F price, but the 310 may increase in price when the 1962 models come on the market.

Cabin Arrangement

Despite its lower seating capacity, the 320 will compete directly with the Beech J-50 and the Commander 680F, Cessna believes. Cessna surveys show that the average business trip by privately owned aircraft is made with only three persons on board. Cessna's premise is that most corporations would rather have a smaller aircraft at lower cost than pay for a larger plane with same performance when extra capacity will go unused most of the time.

The Skyknight has four cabin seating arrangements with a maximum capacity of five passengers. The layouts include a five-seat arrangement with the fifth seat on the left, behind the two second row passenger seats; four passenger arrangements with the rear seats either joined or separated by an aisle; and three single seats plus a lounge-type seat on the left behind the pilot.

Cabin appointments are available in three fabric combinations in the standard configuration or in four all-leather layouts as optional extras. All seats have arm-rests and there is an optional folding table built into the back of the copilot's seat.

A fourth window has been added at the rear of each side of the cabin, increasing window area to 3,937 sq. in. Windows are tinted with the exception of the windshield and windows aft of the pilots' seats are double-pane.

New Goodyear dual-cylinder, disk-

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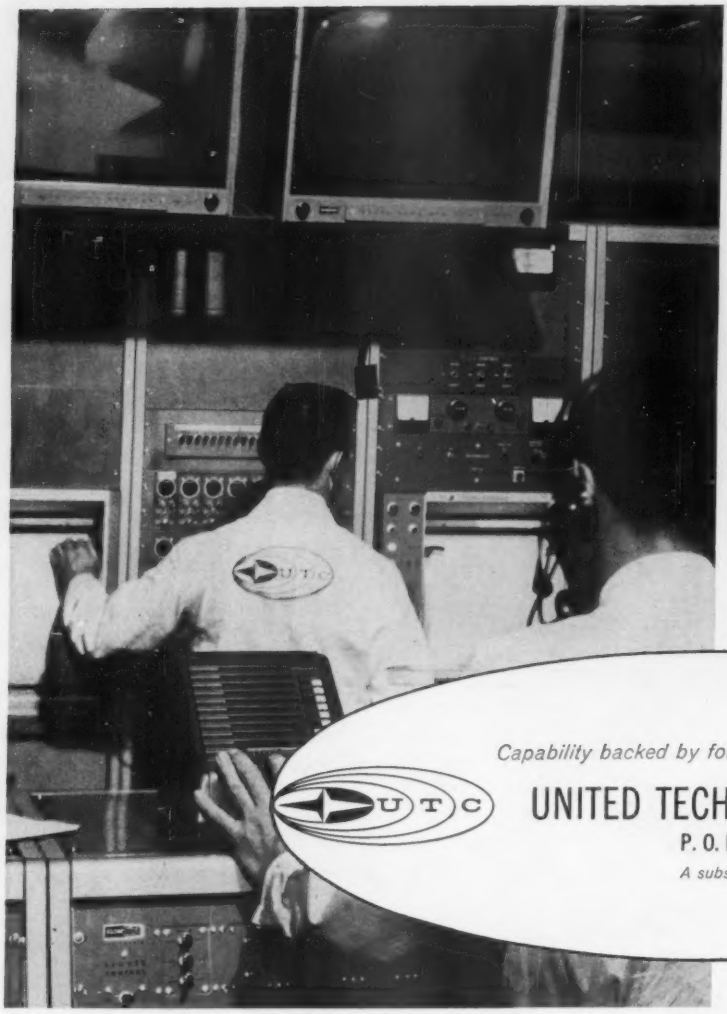

Left—The scene: UTC Development Center. The action: static firing test is monitored on closed-circuit TV in Remote Control and Data Acquisition Center.

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Sr. Design Engineer—Supervision of a group in design of solid rocket motor components. Requires professional degree and a minimum of 5 years rocket design experience.

Engineering Analyst—Systems Design. To formulate mathematical models of systems engineering problems and implement solutions by analytical techniques. Requires degree with solid mathematical foundation and 2 years design or systems experience.

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Aerothemo Specialist—Will perform heat transfer thermodynamic and aerodynamic studies on rocket motors, develop new methods of analysis and design tests. Will consult with designers and project engineers on major engine programs. Requires masters degree in mechanical or aeronautical engineering and 4 years experience in thermodynamics and heat transfer.

Process Engineer—For rocket motor processing studies and process methods improvements. Requires chemical engineering degree and direct propellant processing experience.

Propulsion Engineer—For analytical studies of solid and liquid propulsion systems. Requires degree with extensive mathematics, thermodynamics and fluid mechanics background.

Positions also for process operations supervisors.

All qualified applicants considered without regard to race, creed, color or national origin.

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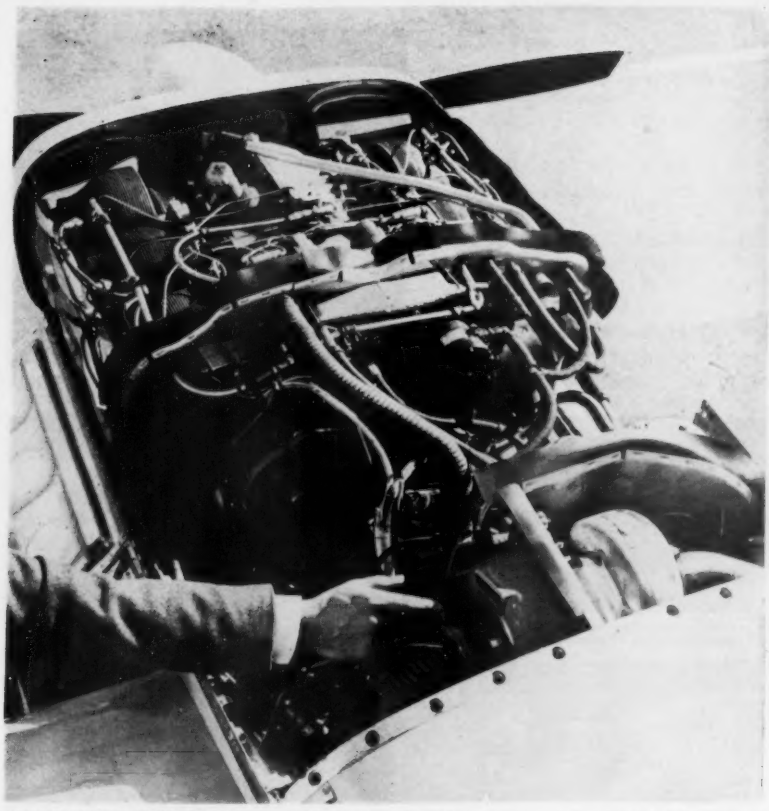
Would you appreciate living in the San Francisco Bay area, which features "West Coast living" at its finest? Plus the possibility of financial gain if you can give evidence of real creativity and initiative? This is what the future holds at UTC. If you are interested, we invite you to contact C. F. Gieseler, Dept. 104-A, United Technology Corporation, Box 358, Sunnyvale, California. All replies treated in strictest confidence.



TURBO-SUPERCHARGER is mounted at rear of engine in the wing. Turbine is exhaust driven and maximum manifold pressure of 35 in. Hg. is maintained by a pressure sensing valve which operates an exhaust waste gate. Skyknight is powered by two Continental TSIO-470-B horizontally opposed, six cylinder fuel injection engines.

Skyknight Dimensions and Specifications

Dimensions	
Wing span	39 ft. 5 in.
Length	29 ft. 6 in.
Height	10 ft. 5¾ in.
Wheel base	9 ft. 6¾ in.
Tread	12 ft.
Horizontal stabilizer span	17 ft.
Vertical stabilizer height	6 ft. 5 in.
Weights	
Empty	3,190 lb.
Gross weight	4,990 lb.
(Full gross weight allows for five persons, full gas and oil load, plus 293 lb. baggage and optional load.)	
Wing and Engine Loadings	
Wing area	175 sq. ft.
Wing loading (at maximum gross)	28.5 psf.
Power loading (at maximum gross)	9.6 lb./hp.
Fuel, Oil Capacity	
Standard fuel arrangement	102 gal. (100 gal. usable)
(Includes two 51 gal. tip tanks.)	
Optional fuel arrangement	133 gal. (130 gal. usable)
(Includes two 51-gal. main tip tanks and two 15.5 gal. auxiliary tanks in wings.)	
Oil capacity	6.5 gal.

type brakes give the Skyknight a shorter stopping distance from takeoff speed than the 310. The Skyknight's brakes can absorb 585,000 ft./lb. of kinetic energy, as compared with a maximum of 490,000 ft./lb. by the brakes on the 310. Tubeless tires and elimination of heat diffusers on the wheels have lightened the over-all weight of the landing gear, however.

Fuel strainer outlets for each main tank have been moved outboard of the nacelles (they are located inboard of the nacelles in the 310) and are simple, spring-loaded tubes which release fuel when pushed up and which close automatically when the pressure is released. Two other fuel drain outlets for the cross feed system are of the same type and are located beneath the right wing fillet.

Radio equipment and a 35,000 Btu. Stewart-Warner heater are located in the nose cone of the Skyknight.

The airplane is designed to carry five adults and full main fuel tanks and has capacity for 293 lb. of baggage and optional equipment, including radio gear. Additional space can be provided for bulky objects by removing rear seats which are mounted on snap-in floor fixtures. Total cabin area is 133 cu. ft.

Major optional equipment, other than radios, available on the Skyknight includes Goodrich Electric propeller anti-ice system, Goodrich de-icer system, 30 gal. auxiliary fuel system, 50 amp., 28 volt generators (25 amp., 28 volt generators are standard), and an oil dilution system.

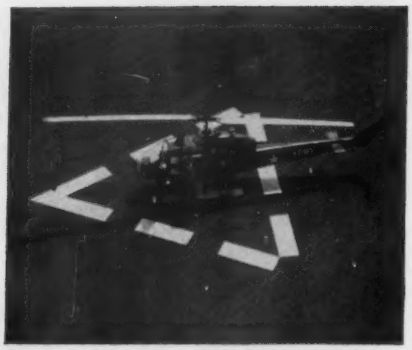
PRIVATE LINES

New Zealand aircraft distributors have ordered 25 Fletcher FU-24 utility aircraft from Fletcher Aviation of El Monte, Calif. The orders total $625,000. The manufacturer already has sold 125 aircraft to various operators in New Zealand during the past five years. Previous orders totaled near $4 million.

N. O. Brantly of Philadelphia, Pa., has been named outstanding general aviation pilot of 1961 by the National Pilots Assn. Brantly was honored for his work in making general aviation flying safer in poor weather and for developing a low-cost helicopter.

Mohawk Airlines has added an upholstery shop to its maintenance base at Oneida County Airport, Utica, N. Y., and is seeking corporate aircraft custom redecoration and rehabilitation jobs. The airline has purchased Aeronautical Upholsterers, Inc., Baltimore, Md. President of the firm, Charles DeBever, will manage the new Mohawk department in Utica.

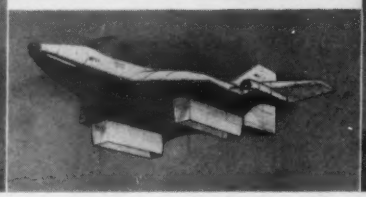
H-23D – won recent major Army contract. New D's will join hundreds of others as backbone of light helicopter fleet.



HO-5 – a design finalist for projected 4,000-unit Army LOH procurement, largest aviation quantity production since 1945.

12E – workhorse of civil utility field, 12E selected to serve light helicopter requirements of Canadian Army and RCAF.

STORC – crane converts for trans-ocean flight; culminates 10 years Hiller pioneering of rotor-tip jets.

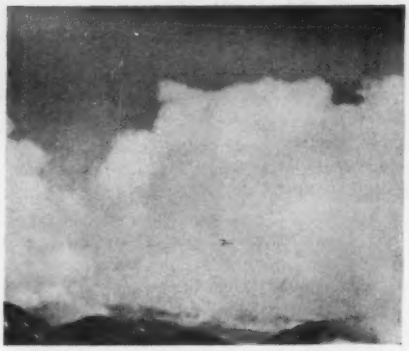


IN DESIGN – Transonic, Supersonic VTOL propulsion systems; Ground Effect Machine Propulsion concepts.

VHR-447 – Vought-Hiller-Ryan building history's first VTOL prototypes; $70 million program for 5 Tri-Service VTOLs.

F4 – new big brother of 12E, versatile E4 triples as VIP transport, utility "station wagon," high-performance Army H-23F.

AN INVITATION TO PROGRESS IN THE DYNAMIC FIELD OF VERTICAL FLIGHT TECHNOLOGY



1099 – 6-place, turbine-powered ultimate in helicopter capability and utility. Hiller sponsored 1099 is now flying.

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3 yrs. exp. checking production design drawings.

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BSAE, 3 yrs. exp. preferably helicopters.

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SUBSIDIARY OF THE ELECTRIC AUTOLITE COMPANY

Financial Briefs

Rixon Electronics, Inc., Silver Spring, Md., reported a Fiscal 1961 net income of $64,541 on net sales of $1,847,016, record earnings for the company's five-year history. Sales increased $756,620 over Fiscal 1960, when income was $62,004. Per share earnings for 1961 were 17 cents compared with 16 cents for 1960.

Martin Co. predicted a 28% increase for 1961 over 1960 in its total purchasing from small businesses. Total Martin buying from small firms in 1960 was $92.6 million. First half of 1961 buying from 12,000 such companies totaled more than $59 million, with a possible full-year figure of $118 million, Martin officials reported.

Clarostat Mfg. Co., Inc., of Dover, N. H., reported a net income of $193,603 for the first half of 1961, based on total sales of $4,639,909. The firm, which produces precision potentiometers and other resistors for missiles, computers, radio, television and other electronic equipment, showed a loss of $4,000 from 1960 income over a comparable period, with per share earnings dropping from 42 to 41 cents. Clarostat President Victor Mucher said the loss was due to unusual expenses incurred in preparation for expanding the company's line of products.

International Rectifier Corp. of El Segundo, Calif., had a net income of approximately $1,080,000, exclusive of profits from foreign affiliates, based on sales for Fiscal 1961 of about $14.5 million. This compares with $1,206,000 earnings on sales of $13,124,586 for the previous year. Preliminary figures showed 1961 earnings per share of 45 cents on 2,410,348 outstanding shares of common stock compared with 50 cents on 2,404,745 shares in 1960. The firm's share of profits from associated foreign companies was about $85,000 with no corresponding earnings in 1960.

Mergers and Acquisitions

Daystrom has sold to Tamar Electronics, Gardena, Calif., the assets and business of Daystrom-Wiancko Engineering Co., a subsidiary, and Daystrom-Pacific, a division, as a result of arrangements completed by Tamar's partner company, Electro-Science Investors, Inc., Dallas-based small business investment firm. Not included in the Tamar acquisitions are land, buildings and equipment, which Daystrom is leasing to the purchaser. Daystrom-Wiancko produces high-accuracy pressure and force transducers; Daystrom-Pacific makes rate and free gyros in the $2,000-$3,000 range.

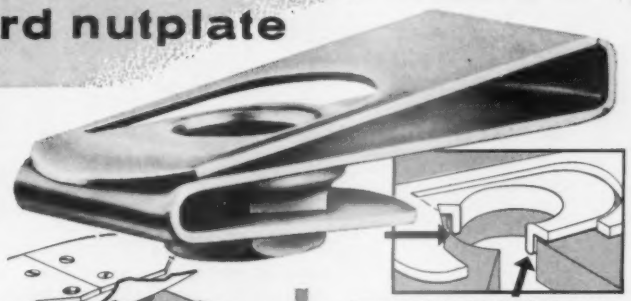
Barnes Engineering Co. of Stamford, Conn., manufacturer of infrared devices primarily for military and space applications, has signed an agreement to acquire Connecticut Instrument Corp. of Wilton, Conn., which manufactures infrared spectrometer accessories. Connecticut instrument will become a Barnes subsidiary.

Burnell & Co., Inc., of Pelham, N. J., manufacturer of electronic filter networks, has acquired 80% of the common stock of GLP Electronics, Inc., of Bristol, Conn., which manufactures tantalum and aluminum foil capacitors.

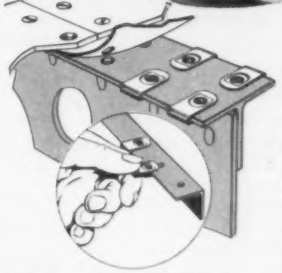
Raytheon and CBS Electronics have agreed on essential terms for purchase by Raytheon of real estate, facilities and certain inventories at Lowell, Mass., from CBS. Agreement was reached following CBS' decision to discontinue its semiconductor operations. Raytheon is not expected to begin operations at Lowell until the actual purchase is made, probably by sometime in mid-October.

Monadnock self-locking CLIP-ON NUT to replace standard nutplate

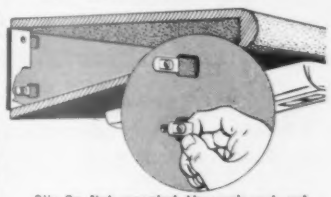
Eliminates costly riveting in structural and non-structural installations. Applied where suitable edge margin exists or through cut-out hole in center of panel, Clip-On Nut quickly slips onto panel or structure and locks firmly in bolt hole. Available for .020" to .150" application thicknesses. No tools required. As integral part of a sub-assembly, Clip-On Nut eliminates additional drawings, part numbers and installation in final assembly traditional with conventional locknuts. One airframe manufacturer reports a savings of 32c each time a Monadnock Clip-On Nut is used in place of nutplate. Clip-On Nut reduces inventory; simplifies design changes, field rework, repairs. Meets MIL-N-25027—120,000 psi class. Write for bulletin.



Drawn eyelet locates Clip-On Nut assembly in application hole. Controlled radius edges developed on eyelet (see arrows) insure smooth installation action.



Clip-On Nuts securing floor panels of Boeing 707 jetliner. Replace riveted nutplates where thickness of upper leaf is not objectionable and suitable edge margins can be provided.



Clip-On Nut mounted through cut-out hole in center of panel when edge margin is excessive.

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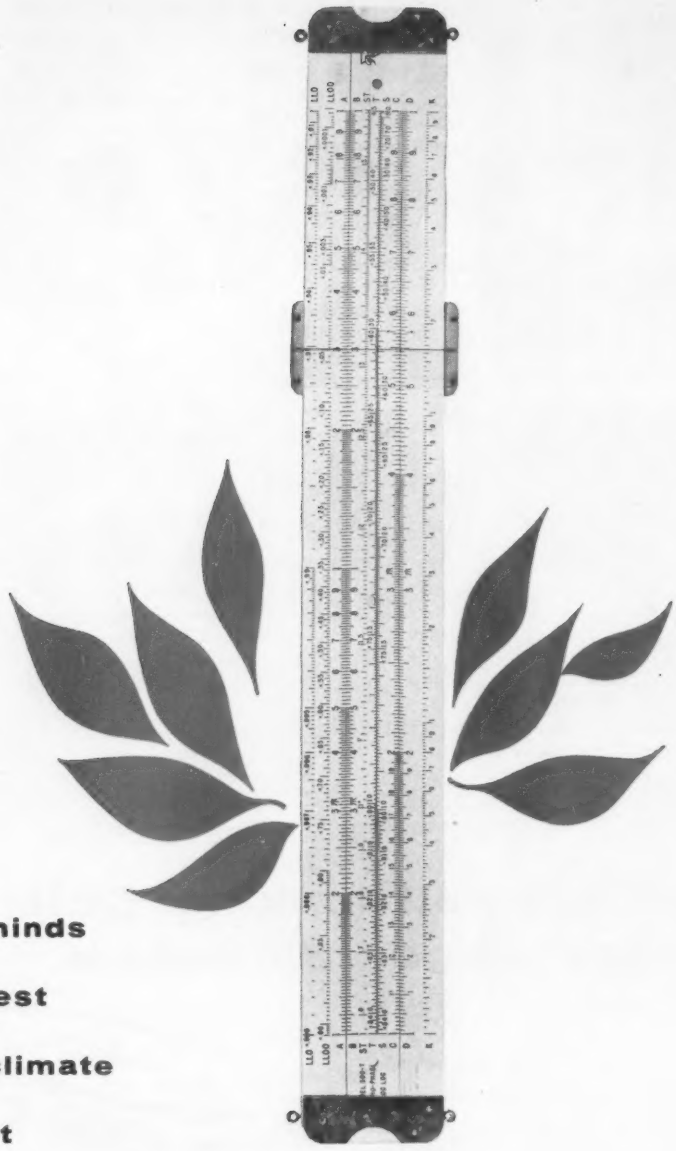

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Transportation Corporation of America, New York, N. Y., engaged in two transportation operations: a regularly scheduled airline, and a transit system in Washington, D. C. Offering is 36,981 outstanding Class A shares at prices not in excess of those prevailing on the American Stock Exchange. The company has entered into agreements which provide for purchase of 18.51% of the common stock of Caribbean Atlantic Airlines in exchange for the 36,981 Class A shares of the company.

Missile Systems Corp., Beverly Hills, Calif., engaged in the manufacture of complete electromechanical assemblies and systems for special weapons programs, and electronic enclosures, and furnishing data processing and documentation services, providing technically trained personnel on a contract basis and preparing technical handbooks and publications. Offering is 140,000 common shares; 100,000 shares by the company, and 40,000 shares by the present holders. Company's proceeds will be used to carry larger inventories and accounts receivable; $600,000 to reduce short-term bank loans; $65,000 for the liquidation of sundry unsecured indebtedness.

National Tel-Tronics Corp., Yonkers, N. Y., engaged in the manufacture of standard and custom-made electronic components. Offering is 133,000 common shares at $3 per share. Proceeds will be applied towards payment of a $50,000 bank loan; improving automating processes and research and development of new products.

Cooke Engineering Co., Alexandria, Va., engaged in developing and manufacturing electronic products and in providing engineering services. Offering is 32,000 common shares at $11 per share. Proceeds will be used to purchase new test and production equipment; for development of new products; sales promotion of commercial products.

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PROBLEMATICAL RECREATIONS 89

A man has an odd number of wires running from his basement to his roof. He has available some numbered tags and a meter which detects open and short circuits. In order to label the corresponding ends of the wires in the basement to those on the roof, what is the least number of round trips necessary?

—Contributed

A line of Elliott-Litton millimeter wave tubes for the 18-80 kmc range is available from our Electron Tube Division. Interested parties might send for the 52-page catalog complete with specs and outline drawings. Write: Electron Tube Division, San Carlos, California.

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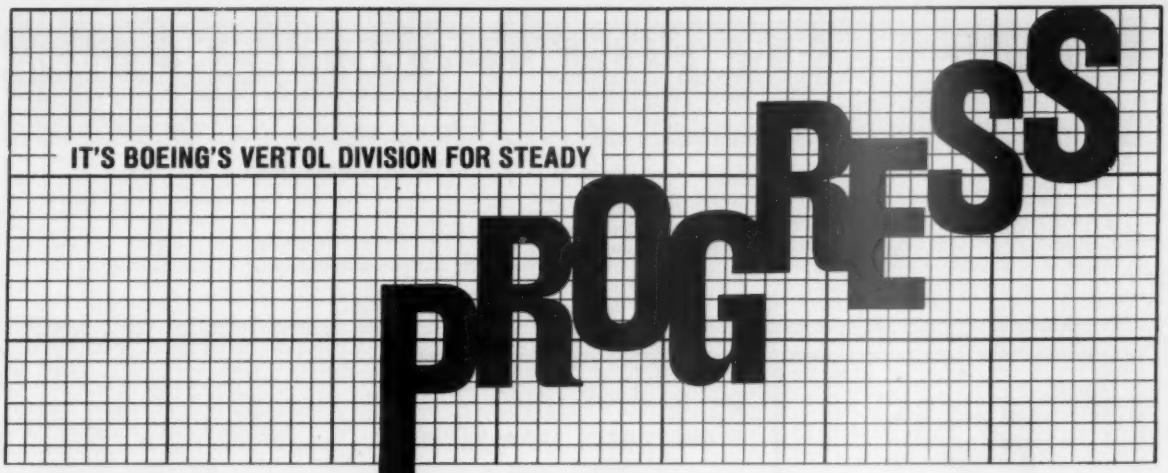

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LETTERS

Space for Profit

In reading your excellent periodical I get the distinct impression that the entire effort of the United States towards research in space, etc. is through, by and for the United States government.

The United States government was never intended to replace or be substituted for free enterprise. The so-called "space race" with the USSR could be won by the United States if it were conducted as a function of free enterprise rather than the United States government.

In defining the above statement:

With private industry engaging its own time and money in space research we would eliminate the war-like implications of government-supported programs; we would take the government off the hook with respect to failures and/or successes; we would inject a direct profit into American industry; and we would still be able to supply the military with the necessary know-how and techniques for developing devices for our national protection.

Form a company (or corporation, or whatever you wish to call it). Finance this new entity with funds from a large number of existing companies and possible public offerings of stock and/or bonds. Limit the life of the new company to a single objective or specific length of time, after which all interests held by other companies will be returned (including previously agreed interest rates), and allow the company to continue to exist as a private enterprise with stockholders. Patents developed and proprietary data would be given to the original participating companies and the government.

The prime purpose of this company would be to put Americans and American industry in space, to exploit space and its limitless resources and power, and unique environment for profit. I firmly believe that no country in the world can compete with American industry when it comes to exploiting an idea.

The original investments could be written off. The total cost of such a program would be a fraction of the government cost—imagine Detroit trying to design and build an automobile to government specifications. There would be no red tape to committees, lobbying, vote-getting, etc. There would be, therefore, a lower overhead and faster timetable.

Failures and accidents (which are bound to occur) would not reflect on the government any more than do similar occurrences when a new car is tested, for example, for a race.

Conflicts of interest such as those that exist between the services and agencies today would be eliminated, and so would the duplication of effort that goes along with these duplications.

In conclusion (and it may sound like I'm waving a flag, but I'm serious), American industry and free enterprise should be interested in advancing the state-of-the-art of rocketry, space planes, space stations, mining the asteroids, space research laboratories, solar power stations, ad infinitum—all for profit—all because it is a new frontier that exists today similar to those of years past that have been conquered and developed by free individuals.

BJARNE E. URSIN
Santee, Calif.

Aviation Week welcomes the opinions of its readers on the issues raised in the magazine's editorial columns. Address letters to the Editor, Aviation Week, 330 W. 42nd St., New York 36, N. Y. Try to keep letters under 500 words and give a genuine identification. We will not print anonymous letters, but names of writers will be withheld on request.

First Regulus I, when undergoing flight tests at Edwards Air Force Base, Calif., in 1950, was equipped with a fake cockpit canopy to delude passers-by into assuming that the missile was a new type of aircraft. Chance Vought control pilot Roy Pearson, who controlled the Regulus from a jet aircraft on its first flight, poses with the disguised missile.

Conservative Protest

I would like to comment on the editorial which appeared in the Aug. 14 issue of your magazine.

The section of the editorial entitled "Conservative Drag" was both disgusting and inaccurate. To begin with, most conservatives recognize the value of a man-in-space program. Beating the Russians to the moon is very important in our struggle against communism.

If your editorial staff members were as widely read as they should be, they would surely be aware that conservatives are leading the anti-communism effort.

It was inaccurate to claim that ultra-conservatism is being "ballyhooed into a home-grown . . . virtue." Conservatism is a desirable virtue and is rapidly gaining favor, particularly at the "grass roots" level. Ultra-conservatism is advocated by very few people because any extreme viewpoint is undesirable.

I hope that you were not trying to associate President Eisenhower with ultra-conservatism, or even limited conservatism. It should be obvious from his words and actions that he is at best a "moderate." Mr. Eisenhower's policies were some times as short-sighted as those of any liberal, and no true conservative would like to be associated with his policies.

In the future please don't be so quick to condemn conservatism, particularly by associating it with anyone whose opinions are distasteful to us conservatives.

JAMES B. FAULKNER
Kent, Wash.

Crash Solutions

For years I have read of the expensive, painstaking and lengthy efforts of both the aviation industry and the government to reconstruct the remains of crashed airliners in an attempt, frequently in vain, to discover the causes of unexplained crashes, usually those without survivors or competent witnesses.

I have a suggestion that I believe has merit, that would certainly almost always guarantee the survival of an expert witness thereby eliminating most of the frustrating efforts referred to above.

Why not require all airliners to furnish at least one ejection seat for the flight engineer or copilot, making its use mandatory when it appears that a crash is unavoidable or imminent?

Think what it would have meant if such a person had been available to the FAA which has just released the findings of the Capital Airlines Viscount crash near Williamsburg, Va., nearly two years ago, or the Hammarskjold crash, the Electra and Connie at Chicago, plus all the tragic rest? Certainly the expense involved would be justified in the possible saving of human lives alone, let alone the speed of finding the cause.

This idea makes sense to me.

J. R. PRITCHARD, JR.
Emporia, Va.

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Hipernas — and many other systems such as the Air Force GSN-5 and the Navy's SPN-10 All-Weather Automatic Landing Systems — typify Bell's capabilities in the broad field of electronics. This diversity of activities offers an interesting personal future to qualified engineers and scientists.

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How the Phantom II Affects Advanced Base Logistics

The combat value of an advanced base is directly related to the efficient use of its supplies. Defense planners, seeking to increase the combat potential of advanced bases, quickly come to grips with the economics of logistics. The two-mission Phantom II simplifies the logistic problem because this one airplane provides the capability for not only air defense, but also for long range air-to-ground strikes and troop support. Yet Phantom II support personnel and equipment requirements are no greater than for other fighters with single mission capability.

The Phantom II can effectively deliver Sparrow III and Sidewinder missiles against air-to-air targets in addition to a full range of ground strike "iron" bombs and nuclear stores. Simply varying the armament of the Phantom II fits the advanced base to shifting combat situations in minutes, in any kind of weather, day or night.

This two-engine, two-man, Mach 2+ fighter holds world speed records for 500, 100, and 3 kilometers, has crossed the continent in 170 minutes, reached an altitude of 98,560 feet and has a dash speed in excess of 1500 mph. Combat equipped, the Phantom II operates easily from existing 5000 foot runways.

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